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of the *Royal Society*,
Octob. 21. 1675.

Ordered,

THAT a Book Intituled, *The Comparative Anatomy of TRUNKS*, together with an account of their Vegetation grounded thereupon; In two parts: the former read before the Royal Society February 25. 1673; the latter June 17. 1675. the whole explicated by several Figures in Nineteen Copper-plates; Presented to the Royal Society in the years 1673. and 1674. by Dr. Nehemiah Grew; be Printed by the assigns of John Martyn Printer to the Royal Society for Walter Kettilby.

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The Comparative
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OF
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Account of their *Vegetation*
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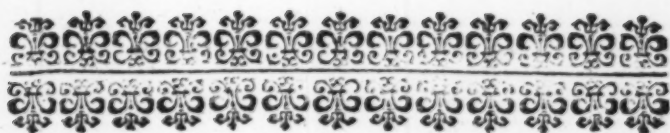
By *Nehemiah Grew*, M. D. and Fellow of
the *Royal Society*.

♠ L O N D O N,

Printed by J. M. for *Walter Kettilby* at the Sign of the
Bishops Head in S. Paul's Church-yard. 1675.

Rec'd Dec. 1906.

W. J. 1793



To the most August Prince,

CHARLES II.

O F

*Great Brittain, France, and
Ireland, King, &c.*

May it please your Majesty,

HAVING formerly dedi-
cated two Essays to
the Royal Society,
of the Anatomy of
Plants; and both with good ac-
ceptance: and Your Majesty like-
wise, upon Your view of them,
having been pleased to speak well
A 2 of

The Epistle

of the same : I am now emboldened most humbly to present a Third into Your Own Royal Hands.

By which Your Majesty will find ; That there are *Terræ Incognitæ* in Philosophy, as well as Geography : For the discovery of this Part whereof, I did resolve to make an Adventure. And I may, without vanity, say thus much, That it was my fortune, to be the first that ever gave a Map of the Country.

Your Majesty will here see, That there are those things, which are little less admirable within a Plant, than within an Animal. That a Plant, as well
as

Dedicatory.

as an Animal, is constituted of several Organical Parts; some whereof may be called its Bowels. That every Plant hath Bowels of divers kinds, containing divers kinds of Liquors. That even a Plant lives partly upon Air; for the reception whereof, it hath peculiar Organs. So that a Plant is, as it were, an Animal in Queers; even as an Animal is a Plant, or rather several Plants, bound up into one Volume.

Again, that all the said Organs, Bowels or other Parts, are as artificially made; and as punctually, for their Place and Number, composed together; as

The Epistle

all the Mathematical Lines of a Flower or Face. That the Staple of the Stuff is so exquisitely fine, that no Silkworm is able to draw so small a Thread. So that one who walks about with the meanest stick, holds a Piece of Natures Handicraft in his hand, which far surpasses the most elaborate Woof, or Needlework in the World.

That by all these Means, the Ascent of the Sap; the Distribution of the Air; the Confection of several sorts of Liquors, as Lymphas, Milks, Oyls, Balsoms; with other Acts of Vegetation, are all contrived and brought about in a Mechanical way.

Dedicatory.

way. In sum, Your Majesty will find, that we are come ashore into a new World, whereof we see no end.

It may be, that some will say, Into another Utopia. Yet not I, but Nature speaketh these things. The only true Pallas, wherewith it is Treasonable for the most curious banded Arachne to compare. In whose name, I, the meanest of her Pupils, do in all humility crave Your Majesties Most Gracious Patronage. Whereof I cannot doubt, whilst I consider Your Royal Propensity in all other like cases: that You are too Great to be moved by the suggestions of Ignorance,

The Epistle

or Prejudice: and that You are often exercised in much higher demonstrations of those Princely endowments of Wisdom, Justice, and Goodness. All which illustrate Your Majesties Imperial Crown, and make You truly August.

Withal, there is βασιλικόν τι, some thing Royal, in Your Majesties Philosophy, as well as Inclinations and Power. Agreeable to the Principles whereof, You have been pleased to Institute that Society, whose business is, an Unbyassed, and Universal search of Truth. Your Majesty deeming it to be as Noble a Design, to enlarge the Territories of Know-

Dedicatory.

Knowledge, as those of Dominion.

If I shall make any further Observations of this, or other nature ; I must needs wish, still to seat my self in a clear Light ; as is that of Your Majesties Favour. You being , as it were, Sol & Anima hujus Insularis Mundi. And therefore no less to so small a part thereof, as is,

Your Majesties

most humble

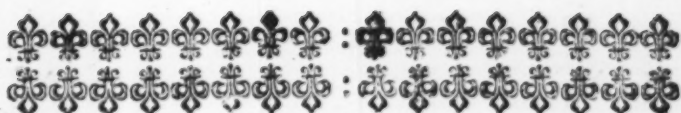
and

most obedient

Servant and Subject,

N. Grew.





To the Right Honourable

WILLIAM

Lord Viscount *BROUNCKER*

THE
PRESIDENT

OF THE
ROYAL SOCIETY.

(Together with the rest of the Fellows
of the said Society.)

My Lord,

HAving in all humility pre-
sented the following dis-
courses to the King, our
Royal Patron : I next
crave leave to do the like to Your
Lordship.

Lordship. You being, in some sense, His Majesties Chancellor in these Affairs ; and having highly justified his choice of you, by that great Prudence and Integrity you have upon all occasions shewed herein.

One Instance whereof hath been afforded us by this present Subject, *sc.* the Anatomy of Plants. Which having been some years since undertook ; and since then Additions made thereunto ; and both published by the Advice of the Royal Society, and the Order of their Council, wherein your Lordship presides : Your Lordship hath thought fit, notwithstanding, lately to give the same Order for the publishing of a like undertaking, by another (indeed a most accurate) Hand. As well knowing, That it would be no disadvantage to the credit of those Matters, which were so new and strange, to be offered to the World from a twofold Authority.

ty. For one, although he have no mind to deceive, yet may sooner be deceived, than two may be. Especially living in divers Countrys, and having had no correspondence. Likewise, that although the same Subject be prosecuted by two Hands; yet would it be still more Illustrated by the various Examples of Both. As also, that like as in other matters, so here the defects of both the Undertakers, would mutually be supplied.

Of these, with Your Lordships leave, I shall give some Instances. In the third Chapter of my first Book I have assigned an Aerial Content to those I here call the Air-vessels; and in the second Chapter of that Book, have given a description of them. Yet so far only, as the unassisted eye would discover: having resolved, for divers reasons, to reserve the Microscopical Part for a second attempt. But what could not be observed

served by the bare eye, the Learned *Marcellus Malpighius*, by the help of Glasses, did in his first Book (which the Learned Mr. *Oldenburge* calleth his Idea) superadd, *sc.* their Spiral Texture. By which Observation, I do say, in the words of the Learned *Grotius* upon the like occasion, *Profecisse me non diffueor, quin gaudeo etiam gloriórque.*

In like manner, such observations as Signior *Malpighi* had not inserted into his first Book, were to be found in my first. As for example, A description of the Florid Attire, in all Corymbiferous, and other similar Flowers: of the Acetary in the center of all sorts of Pears: of the Stone in all sorts of Plums: of a third and inmost Cover, found in almost all Seeds whatsoever, and often analogous to a Secundine: The prodigious swelth of the Covers (especially in Stone Fruits) upon the Generation of the seed,

seed, and their contraction afterwards; after the manner of the Womb in some Animals : with divers others : some whereof are now to be found in Signior *Malpighi's* second Book, and some are there still wanting. The same worthy person being now pleased likewise, to use the self same Names which, having procured my Book (sent him by the Learned Mr. *Oldenburge*) to be translated into Latine, he saw I did therein give to some of the said described Parts.

Again to his observation of the spiral Texture of the Air-vessels, in my second Book I have added a further description of the said Vessels.

Once more, whereas saying little of Roots, he hath applyed himself chiefly to discourse of Trunks : on the contrary, in my second Book, I have made it my business, to treat more largely, and to give the Comparative Anatomy of Roots. For this
amongst

amongst other reasons, that hereby the nature of both Parts might be still more fully and perspicuously represented betwixt us Both.

Upon the consideration of all which I am, my Lord, very sensible, as of that great Justice you have done to the Subject treated of ; so honour to my self, in having assigned unto me so eminent a Collegue.

As to the following Anatomy, I shall give your Lordship the trouble of noting ; That I have varied from Signior *Malpighi* in, I think, all the Examples here exhibited. As also, that some progress is here made beyond what your Lordship will find in the abovesaid Learned Author. As for example, in a further discovery of the Fabrick or Structure of the Lymphæducts ; of the Air-vessels ; and of the Pith : and in sundry particulars more. For which reason, I thought it more proper to follow the said worthy

worthy Author, in the publishing hereof, rather than to precede him : although the Figures, your Lordship may remember, were presented to the Royal Society long ago, and most of them two years since. Lastly, that I have chosen to give my examples chiefly in the transverse Section ; whereas those of Signior *Malpighi*, are principally in cutting by the length. Which I have done chiefly for this reason, Because, that as the Variety of the parts (as to Size, Number, and Position) in every species ; so their Regularity and Constancy in the individuals of each, are this way, much more clearly and certainly represented. Without a distinct remark of which circumstances, the Generation of the various kinds of Liquors in Plants, and divers other particulars, cannot possibly be understood. All which your Lordship will best observe, by comparing our several Figures together. a And

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And for the subsequent discourse, grounded on this Anatomy; I humbly submit the same to your Lordships Judgment; which must needs be candid and benign, because it is great. I have only this to say,

Ες Τελευτὴν περιέμμενοι ἦσαν Ἀχαιοί.

Your Lordship will not disapprove the Enterprize, though as yet it falls short of perfection. It being the result of your Lordships manifold Virtues and Abilities, That you know how far to encourage the meanest attempts; as well as rightly to value, and assist the greatest performances. Upon the account whereof, it is even my ambition to be,

My Lord,

Your Lordships

most obsequious

and humble Servant,

N. Grew.



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E R-

ERRATA.

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or *near*. p. 11. l. 18. r. *cutis*. p. 22. l. 27. for *many* ; r. *any*.
p. 28. l. 1 r. *but alwayes*. p. 29. l. 25. r. *Branchia*. l. 27.
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l. 20. r. *standeth*.

THE

REPORT

The following is a list of the names of the persons who have been appointed to the various positions in the Department of the Interior, and who have been sworn in as such, in accordance with the provisions of the Act of March 3, 1879, entitled "An Act to provide for the better management of the public lands, and for other purposes."



THE
Comparative Anatomy
OF
TRUNKS.

CHAP. I.

TO the end we may know and clearly understand, what the *Trunk*, *Stalk*, or *Branch* of a *Plant* is; I shall, by these *Figures* here before us, describe the several *Parts* whereof it is compounded.

And, for examples sake, I shall in the first place, describe the *Trunks* of six several kinds of *Plants*, as they appear to, and are observeable by the naked eye. Which having done, I shall next proceed to a more particular Description of divers o-
B ther

2 The Comparative Chap. I.

ther *Trunks* and *Branches* as they appear through the Microscope I made use of. In both shewing, not only what their several *Parts* are, as belonging to a *Branch*; but also by a comparative prospect, in what respects they are specifically distinguished one from another, in the several species of *Branches*.

LET the First *Trunk* then to be described, be that of *Borage*: in a *slice* whereof cut transversly, appears, first a tough, yet fine and transparent *skin*. Within this *skin* there is also a slender *Ring* of *Sap-Vessels*: which, without being crushed in the least, do yield a *Lympha*.

Next standeth the *Parenchyma* of the *Bark*. Which is every where made up of a great number of very small *Bubbles* or *Vesicles*. Upon the inner *Verge* of this *Parenchyma*, standeth another *Ring* of *Sap-Vessels*: which also yeild a *Lympha*; and that different, as is probable, from the *Lympha* in the utmost *Ring*. Hitherto goes the *Bark*.

Adjacent to the *Ring* of *Sap-Vessels*, on the inner *Verge* of the *Bark*; stand the *Air-Vessels*, on the outer *Verge* of the *Pith*. Not in a *Ring*; but in Several *Parcels*; some *parcels* in the figure of little *specks*; others in little *arched* lines, almost like an V
Consonant.

Chap. I. Anatomy of Trunks. 3

Consonant. And being viewed in a good *Glass*, there appears to be within the compass of every larger *speck*, about 20 or 30 *Air-vessels*; and within the smallest about 8 or 10.

The *Pith*, in a well grown *stalk*, is always hollow. But originally it is entire. It is wholly made up of a great number of *Vesiculæ*; being pentangular, sexangular, and septangular. And most of them larger than those of the *Bark*; so as to be plainly visible to a naked eye.

LET the next be *Taraxacum*, or *Dandelion*. In a *slice* whereof cut alike transversly, is seen, first a *skin*, then a simple, white, and close *Parenchyma*; made up likewise of *Vesiculæ*; but those exceeding small.

Within this white and thick *parenchymous Ring*, stand the *Milk-vessels*, in several distinct *Columns*, of different size; each *Column* being made up of 7. or 8. *arched lines*. Betwixt these *Columns*, run as many *Diametral Portions*, derived from the said white and thick *Parenchyma*, into or towards the *Pith*.

Next within these, stand the *Air-vessels*. Which are likewise divided, by the said *Diametral Portions*, into divers *arched lines*. The size of these *Vessels*, as well as their number is less than in *Borage*.

4 **The Comparative** Ch. 1.

Within these stands the *Pith*, consisting of very small *Bubbles* or *Vesicles*, as the *Bark*. 'Tis very small, the *Diameter* hereof, being scarce one fifth of that of the *Pith* of *Borage*. But the *Bark* of *Borage* is not half so thick as this of *Dandelyon*.

A *THIRD Trunk*, shall be that of *Colewort*. Wherein cut in like manner as before, may be observed, first a *skin*. Next to which, a very close and darkish *Parenchyma*. Wherewith are mixed some few *Sap-vessels*, which give it that hew.

Within this stands a *scalloped parenchymous Ring*, or a *Ring* of many short and slender white *Arches*. Which every where meeting together, run in so many white *Diametral Portions* into the *Pith*.

Next to the said white *Arches*, and betwixt the said *Diametral portions* stands as many small *parcels* of *Sap-vessels*, like so many little *half-ovals*. Within each of which, is included a white *Parenchyma*.

On the inner *verge* of the *Bark* stands another sort of *Sap-vessels*, in one slender and entire *Ring*. And so far goes the *Bark*.

Next within this *Ring* stand the *Air-vessels*, in several *parcels*, diametrically opposite to the said *parenchymous parcels* next without the *Sap-Ring*.

Last

Ch. I. Anatomy of Trunks. 5

Last of all, and more within the *Pith*, stand the same kind of *Sap-vessels*, as those of the *Half-ovals*. Both these, by small lines, run one into another; thus on both sides, hemming in the *Air-vessels*, and so making altogether, so many little *Pyramids*.

LET a fourth be *Holyoak*. Wherein, being cut as before, next to the *skin* stands the *Parenchyma*, somewhat close; and, in proportion thick.

Towards the inner *verge* hereof, stand one sort of *Sap-vessels*, postur'd in short *Rays*. These *Vessels* yield a *Mucilage*. And on the inner *verge* of the *Bark*, stands a thin *Ring* of other *Sap-vessels*.

Next within the *Bark* stand the *Air-vessels*, postur'd likewise in short *Rays*, diametrically opposite to those in the *Bark*. In every *Ray*, there are about 12. or 16. *Vessels*.

Lastly, and more within the *Pith*, there stand other *Sap-vessels*, all in very thin or slender *Chords*; thus hemming in the several *parcels* of *Air-vessels*.

For a fifth, I will take that of wild *Cucumber*. Wherein first of all next to the *skin*, there is a *Ring* of *Sap-vessels*. Which *Ring* is also made up of *rays*, all poynting to, and most of them terminating on the *skin*.

6 The Comparative Ch. 1.

Next of all there is a thick, and simple *parenchymous Ring*. On the inner *verge* whereof, there are other *Sap-vessels* standing in *parcels*, also in a *Ring*. So far goes the *Bark*.

Next within stand the *Air-vessels*, in as many *parcels* contiguous to those of the *Sap-vessels* aforesaid. To which likewise are adjoined as many more *parcels* of *Sap-vessels* within the *Pith*, opposite to the said *Sap-vessels* within the *Bark*.

LET the sixth be the *Trunk* of *Endive*. In which, next to the *skin*, there is, first a thick and simple *Parenchyma*. Then there is a kind of *undulated Ring* of *Milk-vessels*. Within which stand a sort of *Lymphæducts*, in several *parcels*, some in *arched half-ovals*, others in short slender *rays*. Betwixt these *parcels*, many of the *Milk-vessels* likewise stand.

Next there is an *undulated Ring* of other *Lymphæducts*, parting, as in most *Trunks*, betwixt the *Bark* and the *pith*. Within which are the *Air-vessels*. And within these more *Sap-vessels*. Both of them in small *specks*, answerable, or opposite to the *rays* in the *Bark*.

All the *parts* of these six *Trunks*, may as I have now described them, be observed, without a *Microscope*: excepting only the number of the *Air vessels*. Yet three things

Ch:2. Anatomy of Trunks. 7

things are necessary; viz. a good eye a clear sight, and a Razor wherewith to cut.

CHAP. II.

INOW proceed to a more particular Description of several *Trunks* and *Branches*, as they appear through the best *Microscopes*.

Now the *Trunk*, or *Branch* of every *Tree* hath three general parts to be described; sc. the *Bark*, the *Wood*, and the *Pith*. That likewise of every *Herbaceous Vegetable*, hath either the same three parts; or els three parts analogous; sc. the *Cortical*, the *Lignous*, and the *Pithy* parts.

The *Bark* consisteth of two parts, sc. the outmost *skin*, and the *main Body*. The *skin* is generally composed of very small *Vesicles* or *Bladders*, cluster'd together. That is, originally; but as the *Plant* grows, the the *skin* dries, & the said *Bladders* do very much shrink up and disappear.

Amongst these *Bladders* of the *skin*, there are usually intermixed a sort of *Lignous Fibers*, or *Vessels*, which run through the length of the *skin*; as in *Mallow*, *Nettle*,

8 **The Comparative** Ch. 2.

Borage, Thistle, and molt Plants. Which is not only argued from the toughness of the *skin* by means of the said *Vessels*; but in some *Plants* may be plainly seen, as in *Teasle*.

Whether they are *Air-vessels*, or *Sap-vessels*, is dubious. For on the one hand, because they emitt no *sap*, or *bleed* not, 'tis propable that they are *Air-vessels*. On the other hand, they may be *Sap-vessels*, notwithstanding. Because the non-emission of *sap* is not an infallible and concluding argument of an *Air-vessel*.

For there are some *Plants* which *bleed* not. Which yet are furnished with *Sap-vessels*, as certainly as any others which *bleed*.

The *skin* of the *Trunk* is sometimes visibly porous. But no where more, than in the better sort of walking *Canes*; where the *pores* are so big, as to be visible even to the naked eye; like to those upon the ends of our fingers. See Fig. 7.

The *main Body* of the *Bark* consisteth likewise of two parts, sc. *Parenchyma*, and *Vessels*. The *Parenchyma* is made up of an innumerable company of small *Bladders* clustered together. Differing in nothing from those aforesaid in the *skin*; saving that they are much larger; and generally rounder.

This

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This *Parenchyma* of the *Bark* is the same as to its *Substance*, both in the *Root* and *Trunk*. Yet as to the *Texture* of its *parts*, in the one, and in the other, there is this observable difference, *viz.* That in the *Bark* of the *Root* cut transversly, the said *Parenchyma* is usually more or less, disposed into *Diametral rays*; running through the *Bark*, after the same manner, as do the *hour lines* through the margin of the *Dial-plate* of a *Clock* or *Watch*. Whereas here in the *Bark* of the *Trunk*, the said *Parenchyma* is rarely thus disposed into *Diametral Rays*: nor when it is, are those *rays* continued to the circumference of the *Bark*; as in the *Bark* of the *Root* they frequently are. What is further observable in the *Texture* of the *Parenchyma*, I shall shew in the description of the *Pith*.

The *Vessels* of the *Bark*, are as I shall also shew, diversified many ways. But there are some things, wherein in all sorts of *Plants*, they agree. First, in standing, most numerously, or near, the inner Margin of the *Bark*. Secondly, in being always, and only *Sap-vessels*. I have viewed so many, that at least, I can securely affirm thus much, that if there be any heteroclital *Plants*, wherein they are found otherwise, there is not one in five hundred. Thirdly,
in

in being always *conjugated* or *braced* together in the form of *Net-work*: although the number and distances of the *braces*, are very different: as I have already shewed by divers *Figures* in my *Anatomy of Roots*.

The Properties, whereby the said *Vessels* of the *Bark* are specificated and distinguished one from an other, both in the same *Plant*, and in the several species of *Plants* are very many. Which properties are not accidental, but such as shew the constant and universal design of nature. All which shall be demonstrated by several *Figures*, representing so many *quarters* of the *slices* of so many kinds of *Branches* cut transversely.

FIRST then, for the eight first *quarters*, the *Vessels* of the *Bark* are only of *two kinds*. And those likewise only *Lymphæducts*. Yet in all the eight, they are in respect both of their *proportion*, and *position*, very different. So in *Hazel* and *Ash* they are but few. In *Holly* and *Barberry* more. In *Apple*, *Pear*, *Plum*, *Elm*, still more numerous. And of those three *Fruits*, in an *Apple*, or *Plum*, more than in a *Pear*.

Again, as their *proportion*, so likewise their *position* is divers. For in *Holly*, the inner *Vessels* next to the *wood* stand in *rays*,
Yet

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Yet so thick together, as to make one entire *Ring*. In *Hazel*, they stand more in oblong *parcels*. In *Barberry* they stand likewise in *parcels*, but they are so many *half-ovals*. The utmost *Lymphæducts* of all three, make three rings.

Again, in *Apple*, *Pear*, and *Plum*, the inmost *Lymphæducts* are *radiated*. The utmost are neither *radiated*, nor make an *entire ring*; but stand in *peripheral parcels*. Much after the same manner they also stand in *Elm*. In *Ash*, the said *Vessels* make two *rings*, but neither of them *radiated*: the inmost *ring* consisting of *arched parcels*, and the utmost of round ones. And whereas in all the foregoing, the inmost are still contiguous to the *wood*; and the utmost more or less, distant from the *cuts*: here, on the contrary, the inmost are distant from the *wood*, and the utmost contiguous to the *cutis*.

All the said *Vessels* in the *Barks* of the said eight *Branches*, though I call them *Lymphæducts*; because I observe not any of them to emitt any *liquour*, but what is clear, & less oily: Yet are they not one, but two distinct kinds of *Lymphæducts*. Which is evident, as from some other reasons, so from hence; In that their *positions* are altogether heterogeneous: Yet in both
constant

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constant, regular and uniform. I say, there can be no reason given, why the self *same kind* or species of *Vessels*, should have a different, yea a contrary *position*, and that contrariety not accidental, but *regular* and *constant*.

O F the three next *quarters* sc. the ninth, tenth, and eleventh, the *Vessels* of the *Bark* are different in *number*, *position*, *size*, and *kind*. In *Pine*, which is the eleventh, they are fewer. In *Wallnut*, the ninth, more. In *Fig*, the tenth, most numerous.

So for their *position*. In *pine*, the inmost make a *radiated ring*. The utmost stand stragling up and down, without any certain order. In *Wallnut* the inmost make also a *radiated ring*; The utmost make a *doubble ring*; not *radiated*, but of *round parcels*. In *Fig*, the inmost make also a *radiated ring*. But the utmost make a *double* and sometimes *treble ring*, not of *radiated*, not *round*, but *arched parcels*.

Thirdly, they are also different in *kind*. Those I think, of the two former, *Wallnut* and *Fig*, are thus different: those certainly, of the *Fig*, are so; being *Lymphæducts* and *Lacteals*. The *Lymphæducts* make the inmost *radiated ring*. The utmost, which make the other *rings* in *arched parcels*, are the *Lactifers*.

That

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That they are distinct *kinds* of *Vessels*, is evident from two reasons. First, from their *position* in the *Bark*, which is altogether unlike, as hath been said. Secondly, from the most apparent diversity of the *Liquours* or *Saps* which they contain, and which upon cutting the *Branch* transversly, do distinctly *bleed* from them. Which is one way, whereby we do distinguish the *Vessels* of *Animals* themselves. As in the *Liver*, it were hard to say, which is a *Blood-vessels*, and which is a *Bile-vessel*, where they are very small, if it were not for the *contents* of both.

Those in the *Bark* of *Pine*, are likewise of two *kinds*. The inmost are *Lymphæducts*, as in the two former. The utmost are not *Milk-vessels*, but *Gum-vessels*, or *Resiniferous*. Out of these *Vessels*, all the clear *Turpentine*, that drops from the *Tree*, doth issue.

Besides the difference of their *position*, and of the *liquor* which they contain, and *bleed*; there is yet a third, and that is, their *size*. Most of them being of so wide a bore, as to be apparent to a naked eye. Whereas that of the *Lymphæducts*, can hardly be discovered by the best *Microscope*.

The same *Resiniferous vessels* of *Pine*, are like-

likewise, by their *size*, remarkably different from the *Milk vessels* of *Fig*. For those of *Fig*, are, in comparison, exceeding small; every *Arch*, not being a *single vessel*, but a *parcel* or *cluster* of *vessels*; whereof an hundred or two hundred may make up one *arched parcel*. Whereas one single *Gum vessel* in *Pine*, is sometimes as big as two whole *Arched clusters*, that is, as two or three hundred of the *Milk-vessels* in a *Fig tree*. And the said *Gum-vessels*, or *Turpentine-vessels* of *Pine*, being compared with the *Lymphæducts* of the same *Tree*, one *Gum-vessel*, by a moderate estimate, may be reckoned three or four hundred times wider than a *Lymphæduct*. The like prodigious difference in the *size* of the several *kinds* of *Vessels* of many other *Vegetables* may be observed.

THE three next *quarters* of *Branches*, are of *Oak*, common *Sumack*, and common *Wormwood*. In the *Bark-vessels* whereof, there is yet a farther variety observable. For in all or in most of the above named, there are only two *kinds* of *Vessels* in the *Bark*. But in each of these, there are three *kinds*.

And first, in that of *Oak* there are two *kinds* of *Lymphæducts*, and one of a sort of *Resiniferous*. The inmost *Lymphæducts* make

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a *radiated ring*, contiguous to the *Wood*. The utmost *Lymphæducts* make also a *ring*, but not *radiated*. Those which are a sort of *Rosin-vessels*, stand in round *parcels*; the greater *parcels* betwixt the two *rings* of *Lymphæducts*, and the lesser betwixt the utmost *ring* and the *skin*.

That these are different Vessels from both the other, is evident from the difference of their *position*, as aforesaid. And that they are a sort of *Resinous*, is argued hence; In that, not only *Galls* are very full of *Rosin*, but that the *Bark* of *Oak* it self is also *resinous*. For the conveyance of whose *resinous* parts, it is most unlikely that any other *Vessels* should subserve, but a peculiar *kind*; which are therefore properly called *Resiniferous*.

The next is a *Branch* of common *Sumach*. In the *Bark* whereof, there are likewise three *kinds* of *vessels*. First of all, there is a thick *radiated ring* of *Lymphæducts*; standing on the inner *margin* of the *Bark*, contiguous with the *Wood*. These *Vessels* exhibit their *Lympha* very apparently. A second kind of *Lymphæducts* are situate towards the outer *margin* of the *Bark*, and are composed into distinct *Arched parcels*, all running in a *ring*.

Betwixt the two kinds of *Lymphæducts*
stand

stand the *Milk-vessels*. Every single *Milk-vessel* being *empaled* or hemmed in with an arch of *Lymphæducts*. These *Milk-vessels* are extraordinary large, almost as the *Gum-vessels* of *Pine*; so as easily to be observed without a *Microscope*; and without difficulty to admit a *Virginal wyer*; being two or three hundred times as big as a *Lymphæduct*.

The last, is a *Branch* of common *Wormwood*. In the *Bark* whereof, there are likewise three kinds of *vessels*. First of all, there is a thin *radiated ring* of *Lymphæducts* contiguous with the *Wood* or on the inner margin of the *Bark*. But the *ring* is not entire, but made up of several *parcels*; which are intercepted by as many *parenchymous Insertions*.

A second sort of *Lymphæducts*, or some other *sap-vessels*, are situate about the middle of the *Bark*: and are composed into *arched parcels*, which likewise stand all even in a *ring*.

Beyond these *Arches*, and towards the outer *Margin* of the *Bark*, stand a third sort of *Vessels*, somewhat analagous to the *Milk-vessels* in *Sumach*. Yet different from them, in some part, both as to their *situation* size and *Content*. For in *Sumach*, the *Milk-vessels* stand within the *Arched Lymphæducts*: whereas these in *Wormwood*, stand without them. Like-
wise

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wise being the *Vessels* of an *Herb*, they are far less; *sc.* about the compass or width of a spangle. Their *content*, is not a *Milk*, but a perfect *Turpentine*, or a *liquid* and most *oleous gum*. Or which, for its pleasant aromatickness, may be called a *Balsom*. For it perfectly giveth whatever is in the *smell* and *taste* of *Wormwood*: being the *Essence* of the whole *Plant*, which nature treasur-eth up in these *Vessels*. There are divers other; both *Herbs* and *Trees*, that in the like *Vessels*, contain a *Turpentine* or aromatic *Balsom*; as *Angelica*, *Enula campane*, and others: the *Vessels* being so very large, that they may be easily traced with a knife.

Whether in some *Plants*, there are not more, I cannot say; though we may not have much reason to doubt of it. Because we see, there is so great a variety in the *Viscera* of *Animals*. For what the *Viscera* are in *Animals*; the *Vessels* themselves are in *Plants*.

CONCERNING the *sap-vessels*, I have one observation further to subjoyn, *sc.* as to the *Texture* or *Formation* of the said *Vessels*. I have already said, and shewed, in my former Books of *Plants*, that the *Lignous parts* of all *Vessels* are *Tubulary*. That is, that the *sap* is conveyed, by the
C length

length of a *Plant*, through an innumerable company of small *Tubes*, *Pipes*, or *Vessels*.

The Question may be yet further put. If the *stringy parts* of the *Bark* are made of *Tubes*, what are these *Tubes* themselves made up of? I answer, that not only these *Tubes* or *Sap-vessels*, are *Organical* themselves, but their very *sides* also, are composed of other *Parts*, which are *Organical*, *sc.* of *Lignous Fibers*: which *Fibers* standing close or contiguous in a round, make one *Tubulary Body*, which I call the *Sap-vessel* of a *Plant*. And it is most probable, that these *Fibers* themselves, are also *Tubulary*. That is, that a *Sap-vessel* is a small *Tube*, made up or composed of other yet much smaller *Tubes*, set round together in a *Cylindrical Figure*. As if we should imagine a company of *straws*, which are so many small *Pipes*, to be joined and set round together, so as to make another greater *Pipe*, answerable to a hollow *Cane*. The *Cane*, I say, is as the *Sap-vessels*; and the *straws*, as the *Fibers* whereof it is composed. By which also appears, the prodigious smallness of these *Fibers*. For a small *sap vessel* may, by an indifferent account, be reckoned fifty times smaller than a *Horse hair*. Allowing therefore but twenty of the
afore-

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aforesaid *Fibers* to one *Vessel*; that is to say, ten to compose its *sides*, and ten more to fill its concave; then one of the said *Fibers*, must be a thousand times smaller than a *Horse hair*. Whether the *Fibers* are not made up of other *Fibers*, He only, that made them knows.

The first notice I took of these *Fibers*, and of the *sap-vessels* their being composed hereof, was in a very white and clear peice of *Ash*, torn, with some care, by the length of the *Tree*, and objected to a proper Light. They are also sometimes discernable in some other clear *Woods*, as in very white *Fir*, &c.

Divers considerations have confirmed me in the truth hereof. Whereof, at present, I will mention these two. First, that herein the Analogy betwixt the *Vessels* of an *Animal* and a *Plant*, is very clear and proper. For as the *sanguineous vessels* in an *Animal* are composed of a number of *Fibers*, set round in a *Tubulary Figure* together: so are these *sap vessels* of a *Plant*. Secondly, in that herein, there is a more gennine resemblance betwixt these, and the other *Vessels* of a *Plant* it self; sc. the *Air-vessels*; which are made up of a certain number of round *Fibers*, standing collaterally, or side to side, as I have also observed in my *Anato-*

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my of Roots. So that it is the less strange, that the *Sap vessels* should be made up of *Fibers*, since the *Air-vessels* are so likewise. Only with this difference, that whereas in the *Air vessels*, the *Fibers* are postured *spirally*, and so more horizontally or by the breadth of the *Trunk*: here in the *Sap-vessels*, they stand and are continued in *strait lines*, by the length. And thus far of the *Bark*.

CHAP. III.

THE next general *Part* of a *Branch* is the *Wood*; which lyeth betwixt the *Bark* and *Pith*. And this likewise evermore consisteth of two general *Parts*, *sc.* of a *Parenchymous part*, and of *Vessels*. The *Parenchymous part* of the *Wood* though much diversified, yet in the *Trunks* of all *Trees* whatsoever hath this property, to be disposed into many *Diametral rays*, or *Insertions*, running betwixt so many portions of *Vessels*, from the *Bark* to the *Pith*: as in any of the *Quarters* here before us may appear.

But these *Insertions* are much diversified according to the several species of
Plants.

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Plants. So in *Barberry*, *Ash*, *Pine*, *Wormwood*, they are less numerous. In *Elm*, *Wallnut*, *Fig*, *Sumach*, they are more. And in *Holly*, *Pear*, *Plum*, *Apple*, *Oak*, *Hazel*, are most numerous.

The same *Insertions*, in *Barberry*, *Wormwood*, and in *Oak* many of them are very thick. In *Pine*, *Fig*, *Ash*, of a middle size. In *Pear*, *Holly*, and most of them in *Oak*, are exceeding small. Again, in *Barberry*, *Elm*, *Ash*, *Sumach*, *Fig*, they are of an equal size. In *Holly*, *Hazel*, *Pear*, *Plum*, *Oak*, they are very unequal: some of those in *Holly* being four or five times thicker than the rest; in *Plum* six or seven times; and in *Oak* ten times at least.

They have yet one more diversity, which is, that in divers of the said *Branches*, they run not only through the *Wood*; but also shoot out beyond it, into some part of the *Bark*, as in *Elm*, *Sumach*, *Wormwood*, &c. Whereas in *Pine*, and some of the rest they either keep not distinct from the other parts of the *Parenchyma* of the *Bark*; or are so small, as not to be distinguished there from.

The *Texture* likewise of these *Insertions* is somewhat various. For in *Wormwood*, and most *Plants* they are manifestly composed of small *Bubbles* or *Bladders*: differing

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in nothing from those of the *Bark* or *Pith*, saving in their being much less; especially in the *Branches* of *Trees*. But in *Herbs* they are much larger which leads to the better observation of them in *Trees* likewise. But in many *Trees*, as *Apple*, *Pear*, *Plum*, *Pine*, &c. they are either quite lost, or so squeezed and pressed together by the hard *Wood* standing on both sides, as to be undiscernable. So that the difference betwixt a *Bladder* in the *Pith*, and one of these in the *Insertions*, is only this, that the one is as a *purse* expanded, and the other as the same *purse* contracted, and drawn up together with the strings.

THE *Vessels* of the *Wood*, have likewise much variety. Yet in the *Branches* of all *Trees*, they agree thus far; viz. To be of two general *kinds*; that is to say, *Sap-vessels* and *Air-vessels*: whereas it is proper to the *Bark* to have only *Sap-vessels*. Likewise betwixt the *Sap-vessels*, or *Lignous Vessels* of the *Bark* and of the *Wood*, there is this difference; That those of the *Bark*, upon cutting the *Branch* transversely, do all of them immediately visibly *Bleed*. But these of the *Wood* do not, many of them, sometimes; and most of them never.

These *Sap-vessels* of the *Wood* have likewise some visible variety. Those much less

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less than have the *Air-vessels*, as shall be shewed. As for the reason why I call them *Sap-vessels*, it is to be understood; That every year there grows a new *Ring* of *Sap-vessels* on the inner *margin* of the *Bark*. Which *Ring* hardening by degrees, at the latter end of the year, is turned into a dry and hard *Ring* of perfect *Wood*. So that every year, the *Bark* of the *Tree* is divided into two parts, and distributed two contrary ways. The outer part falleth off towards the *skin*; and at length becomes the *skin* it self. In like manner, as the *Cuticula* in *Animals*, is but the efflorescence of the *Cutis*. I say, that the elder *skin* of a *Tree*, is is not originally made a *skin*; but was once, some of the *middle* part of the *Bark* it self, which is annually cast off, and dryed into a *skin*: even as the very *skin* of an *Adder*, doth upon the gradual generation of a new one underneath, in time, become a *slough*. The inmost portion of the *Bark*, is annually distributed and added to the *Wood*: the *Parenchymous* part thereof making a new addition to the *Insertions* within the *Wood*; and the *Vessels*, a new addition to the *Lignous pieces* betwixt which the *Insertions* stand. So that a *Ring* of *Sap-vessels* in the *Bark* this year, will be a *Ring* of *Wood* the next: and so another

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Ring of Sap vessels and of *Wood* successively from year to year. So the *quarter* for an *Apple branch*, sheweth one of three years growth; that of *Barbery*, of two; that of *Sumach*, of one only; that of *Elm*, of five. Whereby two things may be the better noted. First the difference betwixt the degrees of the *annual* growths of several *Trees*: three years growth in an *Oak*, being as thick as five in an *Elm*; as, by comparing the seventh and twelfth *quarters* together, is seen. Secondly, the difference betwixt the *Annual* growths of the *same Tree*; being not of a constant proportion, but varying in thickness, as it should seem, according to the *season* of the year: whereby it may appear, what *season*, or kind of year, doth most of all favour, the latitudinal growth, or the *thickening* of any *Tree*.

There is likewise some further variety in these old *sap vessels*, whereof the true *Wood* consists; represented in *Wallnut*, *Fig*, and *Oak*. Wherein, a certain smaller number of them stand in a contrary position, to that of the rest; viz. either in small and white *Rings*, as in *Oak*; or else in divers white and crooked *parcels*, as in *Wallnut* and *Fig*. For it seemeth, that, at least, in many *Trees*, some portion of all the *kinds* of *Vessels* in the *Bark*, are not only annually

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ally distributed to the *Wood*, but do likewise therein retain the same, or very like *position*, which they originally had in the *Bark*. So that as all those bigger and darker portions of the *Wood*, were originally, nothing else but the *radiated Lymphæducts* of the *Bark*: so the little white *circles*, or *parcels of circles*, in the same *Wood*, were originally another sort of *sap-vessels* in the *Bark*; *sc.* those which have a circular position therein.

Lastly, as the said older *sap-vessels*, are varied by their *quantity* and *position*; so likewise by their *size*. For in *Oak*, and most hard *Woods*, they are extraordinary small, just discoverable by a good *Microscope*. In *Walnut*, *Fig*, *Hazel*, they are somewhat more patent. But in *Fir*, and some other *Woods* of that *kind*, they are remarkably wider, than in most other *Woods*. I have seen them in *Pine* and *Fir*, ten or fifteen times as big as they are in *Oak*, and are in some sort represented by the smaller black spots which stand in *rays* in the eleventh *quarter*. So that a piece of *Fir-wood*, especially the whiter sort, looks through a *Microscope*, just like the Lattice of a Window; or like the perforated *Wood*, out of which *Button-moulds* have been cut.

OF

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Of the Branches of *Fir*, *Pine*, and others of the same *kindred*, it is also to be noted; That, amongst the said *Lymphæducts*, whereof chiefly the *Wood* consists; there are scattered up and down some few *Gum*, or *Turpentine-veffels*; represented by the larger black spots in the eleventh quarter. Which *Veffels* are *eadem numero*, the self same, which did once appertain to the *Bark*; and do even here also in the *Wood*, contain and yield a liquid *Turpentine*. Only being pinched up by the *Wood*, they are become much smaller *Pipes*.

THE Air-veffels, with the older *Sap-veffels*, and *Parenchymons Insertions*, altogether make up that, which is commonly called the *Wood* of a *Tree*. The *Air-veffels* I so call, not in that they never contain any *liquor*; but, because all the principal time of the growth of a *Plant*, when the *Veffels* of the *Bark* are filled with *liquor*, these are filled only with a *Vapour* or *vegetable Air*.

In almost all *Vegetables*, not one in divers hundreds excepted, this is proper to these *Air-veffels*; To have a much more ample bore or cavity, than any of the *Sap-veffels* in the *Wood*. In the *Wood*, I say; for in the *Bark*, there are many *Sap veffels* bigger than the biggest *Air-veffels* that are.

The

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The varieties hereof are very many; in respect both of their *number*, *size*, and *position*; being the same, in no two *species*'s of *Plants* whatsoever. First in respect of their *number*. So in *Hazle*, *Apple*, *Pear*, they are very numerous; but in different degrees: and are represented in the same Figures, by all the black spots in the *Wood*. In *Holly*, *Plum*, *Barberry* somewhat numerous. In *Oak*, *Ash*, *Wallnut* fewer. In *Pine*, and others of that *kindred*, very few; *sc.* fewer than in any other kind whatsoever.

Secondly, in respect of their *size*; which from the first or greatest, to the least, may be computed easily to about twenty Degrees. Thus many of those in *Elm*, *Ash*, *Wallnut*, *Fig*, *Oak*, are very large. In *Barberry* and *Plum*, not so large. In *Hazle*, *Snmach*, smaller. In *Holly*, *Pear* of a still smaller size. So that many of those in *Elm*, or *Oak*, are twenty times bigger, than those in *Holly* or *Pear*.

And as they have a different size in divers kinds of *Plants*; so likewise, according to the place where they stand, in the self same. So in *Holly*, *Hazle*, *Apple*, their *size* is equaller throughout the bredth of the *Tree*. But in *Barberry*, *Elm*, *Oak*, *Ash*, their *size* in each is very different; not fortuitously

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ously always much after the same manner. For in all the named *Branches*, the *Air-vessels* that stand in the inner *margin* of each annual *Ring*, are all vastly bigger, than any of those that stand in the outer part of the *Ring*.

Thirdly these *Air-vessels* are also different in their *situation*. So in *Apple*, *Wallnut*, *Fig*, they are spread all abroad, in every annual *Ring*; not being posited in any one certain *line*. In others, they keep more within the compass of some *line* or *lines*; either *Diametral*, or *Peripheral*. So in *Holly* they are *radiated*, or run in even *Diametral lines* betwixt the *Pith* and the *Bark*. So also are some of them in *Hazle*; and some few in *Wallnut*.

Whether they stand *irregularly*, or are *radiated*, it is to be noted, that Nature for the most part, so disposeth of them, that many of them may still stand very near the *Insertions*. So in *Apple*, she will rather decline making an even *line*; or in *Holly*, will rather break that *line* into *parcels*, than that the *Air-vessels* shall stand remote from the *Insertions*. To what end she doth this, shall be said hereafter.

Again, in *Ash*, the *Air-vessels* are none of them *radiated*, but most of them stand in *Circles* on the inner *Margin* of every annual

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nual *Ring*. Which *Circle* is sometimes very thick, as in *Ash* and *Barberry*. In others but thin, the *Vessels* standing for the most part single throughout the *Circles*; as in *Elm*. Sometimes again, they both make a *Circle*, and are spread abroad; as in *Pear* and *Plum*.

Those likewise which are spread abroad, are sometimes *regularly* posited. So in *Barberry*, besides those larger, that make the *Circle*, there are other smaller ones, that stand, in oblique *lines*, athwart one another; almost like the *Bend* in an *Escutcheon*. In *Oak*, they make rather certain *Columns*, in the posture of the *Bar*. And in *Elm*, they make, as it were, many *cross Bars*, in the posture of the *Fess*.

This great difference in the *size* and *position* of the *Air-vessels*, in the same individual *Plant*, is one ground, for which I think it probable, that there are *divers kinds* of *Air-vessels*, as well as of *sap-vessels*. Even as in *Animals* there are *divers kinds* of *Organs* for *spiration*, and the separation of *Air*: *Fishes* having their *Bronchiæ*; land *Animals* their *Lungs*; and those in *Frogs*, &c. of a somewhat peculiar *kind*.

The *Texture* of these *Vessels*, and the various ways whereby they may best be observed I have already shewed, in my *Anatomy*

tomy of *Roots*. Yet for our clearer understanding the *Texture* of the said *Vessels*, I will a little further illustrate the same by this similitude. I would resemble it thus, As if a *Ribband* should be wound spirally, and edg, to edg, round about a stick; and so the stick being drawn out, the *Ribband* should be left, in the Figure of a *Tube*, answerable to an *Air-vessel*. A *Ribband*, I say; for that which upon the *unroveing* of the *Vessel*, seems to be a *Plate*; is really *Natural Ribband*: being *not one intire piece*; (nor therefore always of the same bredth) but consisting of a certain number of *round Fibers*, standing collaterally, as the *threads* do in an *Artificial Ribband*. And are also, much after the same manner, by other cross and smaller *Fibers*, *stitched* close up together; as is most apparent in the large and elder *Air-vessels* of *Pine*, *Oak*, and many other *Plants*. What these cross *Fibers* are, will better be understood when we come to the *Texture* of the *Pith*.

C H A P. IV.

THE third general Part of a Branch, is the *Pith*. Which though it have a different name from the *Parenchyma* in the *Bark*, and the *Insertions* in the *Wood*; yet as to its *substance*, it is the very same with them both. Whereof there is a double evidence, *sc.* the sameness of their *Texture*, and their *Continuity*. Their *Texture* shall be shewed presently. As to their *Continuity*, it is to be noted, that as the *skin* is continuous with the *Parenchyma* of the *Bark*; and this *Parenchyma* likewise, with the *Insertions* in the *Wood*; so these *Insertions* again, running through the *Wood*, are also continuous with the *Pith*. So that the *skin*, *Parenchyma*, *Insertions*, and *Pith*, are all one entire piece of work; being only filled up diversly, with the *Vessels*.

The size of the *Pith* is various, being not the same in any two Branches here represented. In *Wormwood*, *Sumach*, *Fig*, *Barberry*, 'tis very large; *sc.* betwixt 5, and 7. Inches Diameter, as it appears through the *Microscope*. In *Pine*, *Ash*, *Holly*, *Wallnut*, not so large; from 3. Inches Diameter to 4. In *Oak*, *Apple*, *Pear*, *Hazel*, lesser, scarce from 2. to 3. In *Damascene*, not above an Inch

Inch and half. And in *Elm*, scarce an Inch Diameter. Note also, that of all *Plants*, *Herbs*, and *Shrubs*, have generally the largest *Piths*, in proportion with the other parts of the same *Branch*, as in *Sumach*, *Fig*, *Barberry* is manifest.

The *Pith* for the most part, if not always, in the *Branch*, as well as *Root*, is compounded of two parts, *sc.* a *Parenchyma*, and *Sap-vessels*. The *Vessels* are here usually postured so, as to make a *Ring* on the *Margin* of the *Pith*. Where they are more numerous, or large, they are more evident; as in *Wallnut*, *Fig*, *Pine*, and others. They are also of divers kinds answerable to those in the *Bark*; as in *Wallnut* *Lympheducts*, in *Fig* *Lactents*, in *Pine* *Rost-nous*.

The *Parenchyma* of the *Pith* is composed of *Bladders*. Which are the very same with those in the *Bark*, and in the *Insertions* within the *Wood*. Only these in the *Pith*, are of the largest size; those in the *Bark*, of a lesser; and those of the *Insertions* least of all: for which reason they are less obvious than in the *Pith*.

The *Bladders* of the *Pith*, though always comparatively great, yet are of very different sizes. Being easily distinguished, even as to their *horizontal Area*, to twenty degrees.

Ch. 4. Anatomy of Trunks. 33.

degrees. Those of *Fig*, *Barberry*, and some others, are large. And of many *Plants*, as of *Thistle*, *Borage*, and others, three times as big again; appearing in the *Microscope*, like to the largest *Cells* of an *Honey-comb*. These of *Plum*, *Wormwood*, *Sumach*, less. Of *Elm*, *Apple*, *Pear*, lesser, Of *Holly* and *Oak*, still less. So that the *Bladders* of the *Pith* in *Borage* or common *Thistle*, are of that size, as to contain, within the compass only of their *Horizontal Area*, about twenty *Bladders* of the *Pith* of *Oak*. Wherefore one whole *Bladder* in *Thistle*, is, at least an hundred times bigger, then another in *Oak*.

Of the size of these *Bladders* of the *Pith*, 'tis also to be noted, that it doth not at all follow the size of the *Pith* it self; but is still varied, according as nature designeth the *Pith* for various use. Thus whereas the *Pith* of *Sumach* is larger than that of *Barberry*; it might be thought, that the *Bladders*, whereof it is composed, should be likewise larger; yet are they three times as small again. So the *Pith* of *Plum*, is far less than that of *Pear*; yet the *Bladders* 4. or 5. times as big. So the *Pith* of *Hazel* is almost three times as little again, as that of *Holly*; yet the *Bladders* in *Hazel*, are ten times bigger, than in *Holly*.

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The *shape* of the *Bladders* hath also some variety. For although, for the most part, they are more round; yet oftentimes they are angular: as in *Reed-grass*, a *Water-plant*; where they are *Cubical*; and in *Borage*, *Thistle*, and many others, where they are *pentangular*, *sexangular* and *septangular*.

Of the *Texture* of the *Bladders*, 'tis also to be noted, that many times, the *sides* of the greater *Bladders* are composed of lesser; as is often seen in those of *Borage* and some other *Plants*. In the same manner, as the *Sap-vessels*, are but greater *Fibers* made up of lesser.

The *Pith*, though always originally composed of *Bladders*, and so one entire piece; yet in process, as the *Plant* grows up, it hath divers openings or *Ruptures* made in it: oftentimes very regularly, and always for good use, and with constancy observed in the same *Species* of *Plants*. In *Walnut* it shrinketh up into transverse films or *Membranes*; as likewise in *Spanish-broom*. Sometimes the *Membranes* reach not from side to side, but about half way, running one against another by a reciprocal Indenture: somewhat after the manner of the *Valvula Conniventes* in the smaller *Gutts*. Sometimes bored with divers *Caverns* by
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Ch. 4. Anatomy of Trunks. 35

the length : sometimes with one great one throughout the *stalk*; and sometimes reaching from *knot* to *knot* ; by which it is divided into several *stories* : and divers other ways.

I SHALL conclude this discourse with a further illustration of the *Texture* of the *Pith*, and of the whole *Plant*, as consequent thereupon. I say therefore, (and have given some account hereof in my *Anatomy of Roots*) that as the *Vessels* of a *Plant*, *sc.* the *Air-vessels* and *Sap-vessels*, are made up of *Fibers* ; according to what I have in this discourse above said ; so the *Parenchyma* of a *Plant* , or the *Bladders* whereof the *Parenchyma* consists, are likewise made up of *Fibers*. Which is true also of the *Parenchyma* of the *Bark*. And also of the *Insertions* in the *Wood*. Yea, and of the *Fruit*, and all other *Parenchymous* parts of a *Plant*. I say, that the very pulp of an *Apple*, *Pear*, *Cucumber*, *Plum*, or any other *Fruit*, is nothing els but a *Ball* of small transparent *threads* or *Fibers*, all wrapped and wreathed up (though in a divers manner) close together. And even all those parts of a *Vegetable*, which are neither formed into visible *Tubes*, nor into *Bladders*, are yet made up of *Fibers*. Which though it be difficult to observe in any of

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those *parts* which are closer wrought; yet in the *Pith*, especially of some *Plants*, which consisteth of more open *work*, it is more visible; and so introduceth the observation hereof, in all other *Parenchymous parts*.

Whence it follows, that the whole *substance*, or all the *parts* of a *Vegetable*, so far as *organical*, they are also *Fibrous*. Of all which *Fibers*, those of the *Vessels*, run up by the length of the *Plant*: these of the *Pith*, and other *Parenchymous parts*, run cross by the breadth or *horizontally*.

BUT WHICH means, the said *Parenchymous Fibers*, in fetching their *horizontal circles*, they first of all *weave*, and make up the *Bladders* of the *Pith* in *open-work*. And the same *Fibers* being continued; they next *weave* and make up the *Insertions* in *close-work*. Amongst which *Insertions* the *Vessels* standing, many of the said *Fibers* wrap themselves also about them; thus *tying* many of them together; and making those several *Conjugations* and *Braces*, of the *Vessels* which I have formerly described. And as some of these *Parenchymous Fibers* wrap about the *Vessels*; so also about the very *Fibers*, whereof the *Vessels* are, as is above said, composed. By which means it is, that all the said *Fibers* of the *Vessels* are
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Ch. 4. Anatomy of Trunks. 37

tacked or *stitched* up close together into one coherent piece. Much after the same manner, as the *perpendicular splinters* or *Twigs* of a *Basket*, are, by those that run in and out *horizontally*. And the same *Parenchymous Fibers*, being still further produced into the *Bark*; they there compose the same *work* over again: only not so *open* as in the *Pith*.

SO THAT the most unfeigned and proper resemblance we can make of the whole *Body* of a *Plant*, is, to a piece of *fine Bone-lace*, at such time, as the women are working it upon the *Cushion*. For all the *Parenchymous parts*, as the *Pith*, *Insertions*, and *Parenchyma* of the *Bark*, are nothing els but *Lace-work*; the *Fibers* of the *Pith* running *Horizontally* as do the *threads* in the *Lace*: and bounding the several *Bladders* of the *Pith* and *Bark*; as the *threads* do the several *holes* of the *Lace*: and making up the *Insertions* without *Bladders*, or very small ones, as the same *threads* likewise do the *close parts* of the *Lace*; which they call the *cloath-work*. And lastly, the *Vessels*, standing *perpendicularly*, run cross to the *Horizontal Fibers*; even as in the *Lace*, the *Pins* do to the *threads*. And this is the true *Texture* of a *Plant*: and the *general composition*, not only of a *Branch*, but of all the

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other *parts*, from the *seed* to the *seed*.
See the Figure representing the *stalk* of
Thistle.

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An Account of the

VEGETATION OF TRUNKS

Grounded upon the foregoing

ANATOMY.

HAVING already given the *Anatomy* of *Trunks*, I shall next proceed to see, what *use* may be made thereof; and principally, to explicate the manner of their *Vegetation*. In doing which, that former *Method*, which I used in shewing the manner of the *growth* of *Roots*, I shall not exactly follow. For so, the general *parts* of the *Root* and *Trunk* being the same, and consequently the *Nutrition* and *Confirmation* of the Or-

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ganical parts of both, being effected in the same way; I should hereby be obliged to the repetition of many things already said: which would be nauseous and unprofitable unto those, who have been pleased to peruse them. The explication therefore of all those things that more especially belong to the *Trunk*, or are more apparent therein, and not spoken of, or not so fully in my former Books, will be my present task. The chief *Heads* whereof, shall be these seven following. *viz.*

FIRST, the *Motion* and *course* of the *Sap*.

SECONDLY, The *Motion* and *course* of the *Air*.

THIRDLY, The *Structure* of the parts.

FOURTHLY, The *Generation* of *Liquours*.

FIFTHLY, The *Figuration* of *Trunks*.

SIXTHLY, The *Motion* of *Trunks*.

SEVENTHLY, And lastly the *Nature* of *Trunks* as variously fitted for *Mechanical use*.

CHAP. I.

FIRS T, as to the *course* of the *Sap*, there are three *parts* by which it *moveth*; *sc.* the *Pith*, the *Wood*, and the *Bark*. First the *Pith*; by which the *sap* moveth the first year, and only the first year. Or, it is *Proprium quarto modo*, to the *Pith* of every *Annual growth*, and to the *Pith* of such a *growth* only, to be *succulent*. That is, whether of a *sprout* from a *seed*, or of a *sucker* from a *Root*, or of a *Cyon* from a *Branch*; The *Pith* is always found the *first* year full of *sap*. But the *second* year, the same individual *Pith*, always becomes *dry*, and so it continues ever after.

One cause whereof is, that the *sap-vessels* in the *Bark*, being the first year adjacent to the *Pith*, they do all that time transfuse part of their *sap* into it, and so keep it always *succulent*. But the same *sap vessels* the year following, are turned into *Wood*; and the *Vessels* which now carry the *sap* stand beyond them, in the *Bark*. So that the *sap* being now more remote from the *Pith*, and intercepted by the new *wood*, it cannot be transfused with that sufficient force and plenty as before into the *Pith*; which therefore from the first year always continues *dry*.

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THE SECOND part by which the *Sap moves sub forma liquoris*, is the *Wood*. Which yet is not in all *Plants*, but only in some, and visibly in few; as in the *Vine*: in which, I say, the *Sap* doth *visibly ascend* by the *Wood*. And this it doth not only the first year, but every year, so long as the *Vine* continues to grow. But although this ascent by the *Wood* be every year, yet is it only in the spring, for about the space of a month; *sc.* in *March*, and *April*.

There are many other *Trees*, besides the *Vine*, wherein at the same time of the year, (and perhaps in all the other *Trees* a little before or after) wherein, I say, the *Sap ascendeth*, though not so copiously, yet chiefly, by the *Wood*. For taking a *Branch* of two or three years old, suppose of *Sallow*, and having first cut it transversely, if the *Bark* be then in the same manner crushed somewhat hard with the back of the knife, near the newly cut end; the *Sap* will very plainly rise up out of the utmost *Ring* of *Wood*. And if it be crushed in the same manner, about an inch lower it will ascend out of every *Ring* of *Wood* to the center. Yet at the same time, which is to be noted, there *ariseth* no *sap* at all out of the *Bark*. Which sheweth the error of that so common opinion, that *the Sap*
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always riseth betwixt the Wood and the Bark. For in the beginning of Spring, it riseth, neither betwixt the Wood and Bark, nor in the Bark; but only in the Wood.

THE THIRD part by which the Sap ascends is the Bark, as may be observed in almost any Branch, cut cross in the late Spring and Summer; either as the Sap is- sueth spontaneously, or upon crushing as a- foresaid. So that when the Sap ceaseth to ascend, sub forma liquoris, by the Wood, then it begins to ascend by the Bark.

Besides the difference of time, the *Organi- cal parts* likewise, by which these two *Saps* ascend, are divers. For in the *Bark*, it ascend- eth *visibly* only by the *Sap-vessels*. Whereas in the *Wood*, it ascendeth only by the *Air-vessels*. That is to say those *Vessels* in the *Wood*, which in the beginning of *Spring* do often times carry *Liquor*: when the *Tree* begins to thrive, and many new parts to be formed and fed, are filled only with *Air*; *sc.* a *Vegetable Air*. The said *Vessels* in the *Wood* have likewise a quite different *Structure*; being composed of *spiral*, but those in the *Bark* of *rectile- near Fibers*; as we have lately shewed. In which *Vessels* of the *Bark* all the *specifical liquors* of every *Tree* are chiefly contained.

FROM what hath been said, we may understand, what is meant by *Bleeding of Plants*

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Plants. If we take it generally, it properly enough expresses the eruption of the Sap out of any Vessels; and so, almost all Plants in Summer time, do Bleed: that is, from Vessels either in the Bark or verge of the Pith: the Saps they Bleed, having either a sower, sweet, hot, bitter, or other taste. At which time, the Vessels also, in the Bark of a Vine Branch, do bleed a sower sap.

But that which is vulgarly called bleeding, as in a Vine, is quite another thing; both as to the liquor which issueth, and the place where it issues: that is to say, it is neither a sweet nor sower, but tasteless Sap; issuing not from the Air-vessels in the Bark. So that there is as much difference betwixt Bleeding in a Vine, or the Rising of the Sap in any other Tree, in March, and in July; as there is betwixt salivation and an Hæmorrhage; or betwixt the course of the Chyle in the Lactiferous Vessels, and the Circulation of the Blood in the Arteries and Veins.

NOW the cause whence it comes to pass, that the early spring Sap of a Vine, and other Trees, ascendeth by the Wood, is in that the young sap-vessels of the Bark, by which the Sap ascendeth all the summer, are as yet but begun to be formed. So that the sap having not yet these Vessels to receive

ceive it, it therefore runs up the *Air-vessels* in the *Wood*. But so soon as the said *Vessels* in the *Bark* begin considerably to encrease, the *Sap* quitting the *Air-vessels*, betakes it self to *these*, as its most proper Receptacles.

The cause else, why the *Vessels* of almost all *Plants*, upon cutting, do yield *Sap*, or *Bleed*; is the *pression* which the *Parenchyma* makes upon them. For the *Pith* and other *Parenchymous parts* of a *Plant*, have upon the reception of *liquor*, a *Conatus* to dilate themselves: as is manifest from *sponges*, which are a substance of the same nature, and have a somewhat like structure: as also from *Cork*, which is but the *parenchyma* of a *Plant*. I say therefore, that the *parenchyma* being fill'd and swell'd with *Sap* hath thereby a continual *Conatus* to dilate it self; and in the same degree, to crush together or contract the *Vessels* which it surroundeth. And the said *Vessels* being cut, their actual *contraction*, and the *eruption* of the *Sap*, do both immediately follow.

It may also be noted, that the *Trunk* or *Branch* of any *Plant* being cut, it always bleeds at both ends, upward and downwards, alike freely. Which, as well as divers other *experiments*, plainly shews, that

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that in the *Sap-vessels* of a *Plant* there are no *Valves*.

FROM what we have now above, and elsewhere formerly said, we may also understand the *manner* of the *ascent* of the *Sap*. As to which I say *first*, that considering to what height and plenty, the *Sap* sometimes ascends; it is not intelligible, how it should thus ascend, by virtue of any one *part* of a *Plant* alone; that is neither by virtue of the *parenchyma*, nor by virtue of the *Vessels* alone. Nor by the *parenchyma* alone. For this, as it hath the nature of a *Sponge* or *Filtre*, to suck up the *Sap*; so likewise, to suck it up but to such an height, as perhaps about an inch, or two and no more.

Nor by the *Vessels*, alone for the same reason. For although we see, that small glass *pipes* immersed in water, will give it an ascent for some inches; yet there is a certain *period*, according to the *bore* of the *Pipe*, beyond which it will not rise. We must therefore join both the *Vessels* and the *parenchyma* together in the service; which we may conceive performed by them in this manner following.

Let A B be the *vessel* of a *Plant*. Let G H be the *Fibers* whereof it is composed. Let C E D F be a number of *Vesiculae* of the

the *parenchyma*, wherewith it is surrounded. I say then, that the *sap*, in the *pipe* B A would of it self rise but a few inches, as suppose from D to L. But being surrounded by the *Vesiculæ* D P the said *Vesiculæ* being swelled with *sap*, press upon the said *pipe* B A. Which being pervious by its *Fibers* G H the *Vesiculæ* at the same time *filtre* or transfuse part of their *sap* thereinto; which will therefore be forced to rise higher therein. And the said *pipe* or *Vessel* being all along surrounded by the like *Vesiculæ*, the *sap* therein is still forced higher and higher. Wherefore the *Vesiculæ* of the *parenchyma*, are as so many *Cisterns* of *liquor*, which being, throughout the length of the *pipe*, contiguous to it, afford it every where a continual supply of *sap*. So that by the supply and pressure of the *Cisterns* or *Vesiculæ* F D the *sap* riseth to L; by those at Q L it rises to M; by those at N M, it rises to I; by those at O I, it rises to K; by those at P K, it rises to E; and so to the top of the *Tree*. And thus far of the *motion* of the *sap*.

CHAP. II.

THE NEXT enquiry to be made, is into the *motion* and *course* of the *Air*. Where this question will first of all be asked; *sc.* which way the *Air* first enters the *Plant*; whether at the *Trunk*, *Leaves*, and other *parts* above ground; or at the *Root*? I answer, *that it enters in part at them all*. For the *inception*, as well as *extramission* whereof, the *pores* are so very large, in the *Trunks* of some *Plants*, as in the better sort of thick walking *Canes*, that they are visible, to a good eye, without a *glass*, but with a *glass* the *Cane* seems, as if it were stuck top full of holes with great *pins*: being so large, as very well to resemble these *pores* of the *skin* in the ends of the *fingers* and *ball* of the *hand*.

In the *leaves* of *Pine*, they are likewise, through a *glass*, a very elegant show; standing all, most exactly, in *rank* and *file*, throughout the length of the *leaves*. The *figure* whereof shall be given hereafter, when I come to the *Anatomy* of the *Leaf*.

But although the *Air* enters, in *part*, at the *Trunk* and other *parts*, especially in some *Plants*; yet its *chief* entrance, is at the *Root*. Even as some *parts* of *Air*, may
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continually pass into the *Body* and *Blood*, by the *habit*, or *pores* of the *skin*; but chiefly, at the *mouth*. And what the *mouth* is, to an *Animal*; that the *Root* is to a *Plant*.

Again, if the chief entrance of the *Air*, was at the *Trunk*; then, before it could be mixed with the *Sap* in the *Root*, it must descend; and so move in a contrary course to the *Sap* throughout the *Plant*. As by its reception at the *Root*, and so its ascent from thence, it hath a more natural and easy motion of ascent: for that the *Sap* of the same *Plant* should continually ascend, and the *Air* descend, would be somewhat strange.

The same is further argued from the fewness and smallness of *diametral Portions* in the *Trunk*, in comparison with those in the *Root*: which nature hath plainly there designed, for the *separation* of the *Air* from the *Sap*, as they are both together received into the *Root*. So that the *reception* and *course* of the *Air*, is made on this manner following.

The *Air* being a *springy* body, it insinuates into all the *Pores* and crannies of the *earth*; and so is perfectly mixed with the soyl. Whereupon, as the *Sap* enters the *Root*, more or less *Air* still intrudes it self

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together with it. The *liquid* portion of the *Sap* swells and fills up the succulent parts of the *Bark*. The *Airy* part is, as was said, separated from the *liquid* into the *Diametral portions*. By which it is conveyed from the *Bark*, and so into the *Air-vessels*; betwixt which *Vessels*, the said *Diametral portions* run from the *Bark* towards the center of the *Root*. The *Air* thus received into the *Air-vessels*, and the reception thereof, by the same means, continued; it is by them advanced into the *Trunk*. In which advance, it is again, more or less, disbursed into all the *parts* of the *Trunk*, as it goes. *Partly* inwards to the *Pith*. From whence the *Pith* is always at length filled with *Air*. *Partly* into the *Insertions*; by which it is conveyed outward into the *Bark*. Wherein, it is in part transfused through the *Sap*; and so the rest, with part of the *Sap*, remitted in *perspirations* back again into the *Air*. So that, whereas the *Diametral portions* in the *Root*, do serve to convey the *Air* from the *Sap* into the *Air-vessels*: on the contrary the *Insertions* here in the *Trunk* serve to convey the *Air* from the *Air-vessels* into the *Sap*. Wherefore, as the *Air-vessels* advance the *Air*; or the *Airy* part of the *Sap*, and so convey it by the length of the *Trunk*; so the *Insertions* filter it,

it, and convey it by the breadth.

A N D that the *Insertions* have this office of *subservience* to both kinds of *Vessels*; doth yet further appear, if we consider, that the *Air-vessels* are always so postured, as to touch upon the said *Insertions*, or at least to stand very near them. For either they are large, and so do frequently touch upon them on both sides; as in *Elm*, *Ash*, *Wallnut*. &c. Or if they are small; then they either run along in even lines collateral with the said *Insertions*, as in *Holly*: or at least, are reciprocally, some on one side, and some on another, inclined to them; as in *Apple*. By all which means, the *Air* is more readily conveyed from the *Vessels* into the *Insertions*.

Again, a further evidence hereof is that generally, the bigger and the more numerous the *Air-vessels* are; the bigger, or at least, the more numerous also are the *Insertions*: especially if the comparison be made (as in all other cases it ought to be, as well as here) betwixt the several *species* of the same kind. So *Corin*, which hath small *Air-vessels*, hath also very small *Insertions*. But the *Vine* hath both very large: and so for others.

Wherefore, the *Insertions* minister betwixt the *Air-vessels* and the *succiferous*; in

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the same manner, as the *Vesiculæ* of the *Lungs*, do betwixt the *Bronchiæ* and the *Arteries*. That is to say, as in an *Animal*, the *Bronchiæ* deposite the *Air* into the *Vesiculæ* of the *lungs*; which administer it to the *Arteries*: so in a *Plant*, the *Air-vessels* deposit the *Air* into the *Insertions*, that is into the *Vesiculæ* of the *Insertions*; by which it is gradually *filtrèd* off into the *Bark* and *Sap-vessels*.

CHAP. III.

A *THIRD* enquiry, is into the *Generation* and *Structure* of *parts*. The manner whereof I have already endeavoured to *explicate* from the *Anatomy* of the *Root*, throughout all particulars. Some whereof I shall yet further clear.

As first the *Union* of the *Bark* to the *Body* of the *Tree*. Contrary to the common opinion, *That they are not continuous*; but that the *Bark* only surrounds the *Body*, as a *scabbard* doth the *sword*, or a *glove* the *hand*. As also seemeth to be proved, by the easy *slipping* of the *Bark* of *Willow*, and most other *Trees*, when full of *sap*, from the *Wood*.

But

But notwithstanding, this, they are as truly continuous, as the *skin* of the *Body* is with the *flesh*: *sc.* by means of the *Parenchyma*, which is one entire *Body*, running from the *Bark* into the *Wood*, and so uniting both together.

Now the reason why the *Bark* nevertheless slips so easily from the *Wood*, is plain, *viz.* Because most of the young *Vessels* and *Parenchymous parts*, are there every year successively formed; that is, betwixt the *Wood* and *Bark*: where the said *parts* newly formed, are as tender, as the tenderest *Vessels* in *Animals*. And we may imagine, how easy it were at once to tear or break a thousand *Vessels* or *Fibers* of an *Embryo*, of a *Womb* or *Egg*.

THE same *Vessels* of the *Bark* are always braced, and gradually fall off together with the *Parenchyma* into the utmost *Rind*. Hence it is, that the *Barks* of many *Trees* are as it were, latticed with several cracks or *fissures*, of divers sizes, in the figure of *Rhombs*: the said *fissures* representing the *Position* and *Tract* of the *Vessels* in their *Braces*. Hence also it is, that the *Bark* of some *Trees*, as of *Corin*, *Cherry*, &c. falleth off in *Rings*, *sc.* because the *Sap-vessels* are posited in the same manner in the *Bark*.

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The *sap vessels*, as they are generated at the inner verge of the *Bark*: solikewise, in a small quantity, at the utmost verge of the *Pith*. Hence it is, that is, by the annual accretion of these *Vessels*, that the *Pith* is sometimes less in the *Trunk*, than in the *Branches*; and less in the elder *Branches*, than in the younger; and sometimes 'tis almost wholly filled up.

SOMETIMES also it breaks and shrinks up, thus making the *Trunk* a *Pipe*. The cause whereof, is either the *Largeness* of its *Pores*, or the *Thinness* of the *sides* of the said *Pores*; upon both which accounts, the *Pith* doth more easily tear, and upon tearing shrink up, and so become hollow: as in Cichory, Lambsana, Sonchus, Teasel, Brownwort, and others; wherein the *Pores* of the *Pith* are *large*, and the *sides* of the *Pores* *thin*. Whereas, upon contrary accounts, the *Piths* of most *Trees*, remain perpetually entire.

THE Reason why *Plants* are made thus to become *hollow*, is *partly*, for the *ripening* of the *Fruit* or *Seed*; which is the better effected by a more plentiful supply of *Air* continually received into their hollow *Trunks*. By means of which *Air*, part of the *sap*, is dried up, and the remaining part of it made warmer, and so sooner matured.

Partly,

Partly, for the better determining the due *Age* of the *Plant*. Hence it is, that the greater part of *Annual Trunks*, are hollow: the *Air* contained in that hollow, drying up the *Sap*, and shrinking up the *Sap-vessels* so far, as to hinder the free motion of the *Sap* therein; from whence the *Plant* must needs perish. So that as the *Content* of the *Air-vessels*, is a kind of *Vegetable Air*, whose office is to *Attenuate*, and *Ferment* the *Juyces* of *Plants*: so the *Content* of these *cavities*, is a more *natural Air*, designed chiefly, so soon as it is convenient, to *dry* them up.

Sometimes, though the *Pith* break, yet not into one pipe, but many *cross Membranes*, as in *Wallnut* and *Spanish-broom*. Because here the dilatation of the *Branch*, and of the *Pith* therein, being much less, in proportion, than its growth in length; the *Pith* therefore, being stretched most by its length, will soonest tear the same way and consequently shrink up into so many *Membranes* by the breadth of the *Trunk*.

AGAIN, as to the *Air-vessels* divers questions may be asked. As how it comes to pass, that they are generally less in the *Trunk* of the same *Plant*, than in the *Root*? The cause whereof is, that here in the

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Trunk, they are more under the power of the *Air*; both that which entereth in at the *Trunk*, and that which of its own nature ascendeth up into it from the *Root*. For the *Air*, as we have elsewhere said, is the mould of the *Air-vessels*, to the crooked particles whereof the *Saline*, and other *principles* concurring to their generation, do conform. To which they do best, the smaller they are: the *Fibers* of the larger *Air-vessels* making greater circles, and so coming nearer to a right line, answerable to the figure of the Particles; not of the *Aerial* but of the *saline principle*.

Wherefore as the *Air-vessels* may be observed still to be dilated or widened towards the lower parts of the *Root*; the *Aerial principle* being there less predominant, and the *Saline* more: So towards the upper part of the *Trunk*, to be contracted or grow smaller; the *Aerial principle* being here more predominant, and the *Saline* less.

FOR the same cause, it may be observed, that the *Air-vessels* of the several years succeeding the *second* year, are near of one size: but those of the *second* year, are usually much larger than those of the *first*, viz. as being under a less power of the

the *Air*. For the first year, the *Pith* being full of liquor, the *Air-vessels* themselves, are the only *Repositories* of the *Air*. Whereas after the first year, the *Pith* becoming dry, or another great *Repository* for the *Air*; the *Air-vessels*, are henceforth filled with a moisture and more *vapourous* and *saline Air*, and so made to grow wider.

For the same cause it is, that the disparity betwixt the *Air-vessels* of the first and succeeding years, is not, where the *Pith* is small, so visible. Because being never capable of containing many *airy* parts of the *sap*, the *Air-vessels* themselves continue still the chief *Receptacles* of the *Air*, and so to be still more equally sized: as in *Hazel*, *Elm*, &c. is seen.

Hence the very *size* of the *Pith*, hath much *influence* upon the *Air-vessels*, and the manner of *nutrition*, and the *Generation* of *liquors* in *Plants*.

LASTLY, for the above said cause, the *time* when the *Vessels* begin every year to be formed or to appear, is always *later*; at least, with respect to the *season* of the *Tree*. So that whereas the *Sap-vessels* begin to be formed in spring: these, not till the latter end of *summer*, or there about; at least not till about that time to appear. That is, when the *sap* begins to decrease,

decrease, and to grow more *airy*; and so more fit matter for the generation of the said *Air-vessels*.

CHAP. IV.

UPON the *Structure* and *Formation* of the *parts*, dependeth the *generation* of *liquors*, as was lately intimated. The *manner* whereof I have formerly shewed, in discoursing of the *Root*. Yet some things I shall here further *explicate*. And *first*, what we have formerly asserted *sc.* That the concurrence of two *specifically* distinct *liquors*, is as necessary to *nutrition* in *Plants*, as in *Animals*. Which appears, as from divers other considerations, so from the very *Structure* of a *Plant*: where in all the organical *parts*, that is the *parenchyma* and the *Vessels*, are every where mixed together *per minima*, that is, *per minimas partes Organicas*, or *Fiber* with *Fiber* of several *kinds*. So that every small part of a *Tree* or of the *Bark* of a *Tree*, is as I may say, a sort of *Linsy Woolsey*. So that there is not the least part of the *Sap*, which is not impregnate with divers *essential tinctures*, as it is continually *filtered* from
from

from the *Fibers* of *one kind*, to those of another ; standing every where *twisted* and *stitched* up together for the same purpose.

FROM the special *nature* and *structure* of the *parts*, the *liquors* of *Plants* are likewise *specified*. The *Vessels* being the chief *Viscera* of a *Plant*. For all *liquors* in a *Plant*, are certainly made by that *Plant*. And since the *Plant* hath no *Viscera* (so called) I would then know, what its several *liquors* are made by ? If in the *parenchyma*, surely by that *parenchyma*. If in the *Vessels*, by the *Vessels*. And if of divers *kinds*, by divers *kinds* of *Vessels*. So that what the *Viscera* are in *Animals*, the *Vessels* themselves are in *Plants*. That is to say, as the *Viscera* of an *Animal*, are but *Vessels* conglomerated : so the *Vessels* of a *Plant*, are *Viscera* drawn out at length.

AGAIN, as the *specifying* of the *sap* dependeth chiefly on the special *nature* of the *parts* : so partly upon the *structure* of the *whole*. Whereby every *part* is still better accommodated with its own *Juyce*. Thus the *Air-vessels* are necessary, not only and barely for a *supply* of *Air* ; but also by their *number*, *size*, and *position* to adjust the quantity of that *Air*, to the government of *nutrition*, and the generation of the

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the *specificall liquors* of every *Plant*. Which is evident from hence, in that they do not follow the *size* of the *Plant*; but are great and many, in some small *Plants*; and small and few, in some others that are large. So *Vines*, and *Corn*, as we have formerly observed, have proportionably a great number of *Air-vessels*, and those very large. By which means the *Sap* is *attenuated* and less oylie and more copiously impregnated with a subtle, *volatile* and winy *spirit*.

For the same reason *Canes*, which yield that sweet *juyce*, whereof *Sugar* is made, and which also aboundeth with a *volatile* and inflameable *spirit*: these, I say, obtain the like over proportion of *Air-vessels*, to what we see in most *Plants*. Hence also it is, that none of the said *Plants* have any considerable *Bark*; that so the attenuating and subtilizing *Air*, may have a more easy and plentiful admission at the *Trunk* also. For which reason likewise the *pores* of the *skin* of some *Canes* are, as hath been observed, remarkably wide.

Hence also it is observable, that of the same *species* or *kindred*, those *Plants* which have the most, and especially the largest *Air-vessels*; have also the greatest abundance either of a *sweet*, or of a *winy liquor*. So in *Apple*, they are larger than in *Crab*;
In

In *Warden*, larger than in *Quince*; and in *Pear-tree*, larger than in *Warden*. So also in *Corin*, larger than in *Goosbery*; and in *Vine*, larger than in *Corin*: and so in others.

AND as the *Air-vessels*, by their *Multitude* and *Largeness*, are accommodated to the better making of a *winy sap*: so by their *fewness* and *smallness*, of an *oyle*. As is remarkably seen in *Fir*, and other *Resiniferous Trees*: these having, if not the *smallest*, yet the *fewest Air-vessels* of all other *Trees*.

IF it be asked, how a *Plant* comes to have any *Oyl* at all in any *part*? Since we see, that the *Sap* by which the *Root* is fed, seemeth to be nothing else but *water*: and that many *Plants* which yield a great deal of *stillatitious Oyl*, as *Mint*, *Rue*, and others, will yet grow in *Water*: I say, if it be enquired how this *Water*, is made *Wine*, or *Oyl*? I answer, that there is no such matter. But that the *Oyl*, and all other *Vegetable principles* are actually existent in, and mixed *per minima*, though in an extraordinary small proportion with the water. Even as we see the distilled *Waters* of *Anise seeds*, *Penyroyal*, and the like, to be impregnated with their own *Oyls*, which give the *tast* and *smell* to such *Waters*.
Wherefore

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Wherefore as a certain quantity of any *salt* may be dissolved in *Water*; beyond which, it will not mix therewith, but remains under its own *form*: So is there a certain proportion of *Oyl*, though far less, which may also be perfectly mixed with *Water*; and is certainly so, more or less, with all the *Water* in the world. But if that proportion, or degree of impregnation be once exceeded; the particles of *Oyl* do then, and not till then, gather into a body, and appear under their own *form*.

I say therefore, that all kinds of vegetable *Principles*, are either in or together with the *Water*, with less difference first received into a *Plant*. But when they are once therein; they are then *separated*, that is to say, *filtered*, some from others, in very different *proportions* and *conjunctions* by the several *parts*; the *Watery* by one *part*, the *Airy* by another, the *Oily* by another, and so the rest: and so every *Part* is the *Receptacle* of a *liquor*, become peculiar, not by any *Transformation*, but only the *percolation* of *parts* out of the *common Mass* or *stock* of *Sap*. And so all those *parts* of the *sap*, which are *superfluous* to any kind of *Plant*, are at the same time, discharged back by *perspirations*, into the *Air*.

And hence, that nature, in the various
perco-

percolations and separations of the *Sap*, may still the better answer her end; hence, I say it is, that she carefully seeth, not only to the special *nature* of the *Organs*, by which she doth her work; but likewise to their very *position*. Thus it is observable, that whereas the *Lymphæducts*, which carry a more *watery liquor*, are still placed on the inner verge of the *Bark*, next to the *Air-vessels*: the *Lactiferous* and *Resiniferous vessels* of *Plants*, to whose *Oylie liquor* a mixture of much *Air* is incongruous; do usually stand, neither on the inner, nor the outer verge of the *Bark*; but in the *middle*. By which means, they are at the greatest distance, and so most secure from the *Air*; either that which enters the *Bark*, at the circumference; or from the *Wood* and *Pith*.

AND because the *Resinous liquors* of *Plants* are more *Oylie* than their *Milky*; their security therefore, from the approach of the *Air*, is yet further contrived. In that in *Pine*, and other *Resinous Trees*, the *Diametral portions* are never found; at least not *visible*: which yet in other *Trees*, are *conspicuous*; being those *parts*, whose office it is, to introduce the *Air* from the *Wood* into the *Bark*.

AGAIN, the *Milky liquors* of *Plants*
being

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being thinner than the *Resinous*, and having a considerable quantity of *water* mixed with their *oyl*; hence it is, that in *Milky plants*, as in *Rhus*, there are a greater number of *Lymphæducts*; and those standing nearer to the *Milky vessels*, than they do in *Pine*, and the like, to the *Resinous*. By which means they are better fitted to affuse their *aqueous* parts more plentifully to the said *Milky liquor*.

FROM the mixture of watery parts with the *Oylie*, it comes to pass, that where-as all *Lympha's*, *Mucilages*, and *Resins* are transparent; the *Aqueo-oleous liquors* of *Plants* are *milky* or white, or otherwise *opacous*. For the same thing is the cause of the whiteness of *Vegetable*, as of *Animal-milk*: that is to say, a more copious mixture of *watery* and *Oylie* parts *per minima*, or into one body. For even the *serous* and *Oylie* parts of *Animal milk*, when thoroughly separated one from the other, they both become very transparent. So the *stillatitious oyl* of *anise seeds*, is most transparent and *limpid*, even as *water* it self: yet there is a known sort of *White anise-seed water*, as it is commonly called: that is to say, wherein the *Oyl*, in distillation, ari-feth and is mixed more plentifully with the *water*. And the *water*, wherein the
stillati-

stillatitious oyl of any *Vegetable* is dissolved becomes a perfect white *Milk*; as in this *Honourable and Learned Presence*, I have formerly had occasion to Demonstrate.

AND that the *Milky liquors* of all *Vegetables* whatsoever, are likewise more *Oylie* than their *Lympha's*, is most certain. For all those *Gums*, which dissolve in *Oyl* or *water* as *Galbanum*, and the like, are originally the *Milky Juices* of *Plants*. And if you take the *Milk* of any *Plant*, as for instance, the *Milk* of common *Sumach*, or of any *tast, bitter, astringent, hot, cold*, or any other whatsoever; and having well dried it, and then fired it at a candle; it will thereupon burn with a very bright and durable flame, even like that of *Tar* or *Turpentine* it self.

FROM what hath been said, we may likewise gather the most genuine import of the word *Gum*, and the distinction thereof both from a *Rosin* and a *Mucilage*. First a *Rosin*, is originally a *Turpentine*, or *Acido-oleous liquor*, having an exceeding small quantity of *watery* parts mixed therewith; and which, for that reason, will not be dissolved therein, but only in *Oyl*. Of this kind are *Mastick*, *Benzoin*, *Taccamahacca*, and divers others, commonly, in our *Bills to Apothecaries*, called *Gums*. Yet,

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in

in strict speaking they are all so many *Rosins*.

Secondly a *Gum*, and every oylie *Gum*, is originally a *milky liquor*, having a greater quantity of *water* mixed with its oylie parts; and which, for that reason, will be made to dissolve either in *Water* or *Oyl*. Of this kind are *Sagapen*, *Opopanax*, *Ammoniac*, and others.

The third sort of *Gum*, is that which is *unoylie*, and which therefore dissolveth only in *water*, as *Gum-arabick*, the *Gum* of *Cherry-tree*, and others such like. This *Gum*, though commonly so called, yet is properly but a dried *Mucilage*: being originally nothing else but the *Mucilaginous Lympha* issuing from the *Vessels* of the *Tree*. In like manner, as it doth from *Cumfry*, *Mallow*, and divers other *Plants*: and even from the common *Cucumber*. The *Vessels* whereof, upon cutting crosse, yield a *Lympha*, which is plainly *Mucilaginous*, and which being well dried, at length becomes a kind of *Gum*, or rather a hardened *Mucilage*. In like manner, the *Gums* of *Plum-tree*, *Cherry-tree*, and the like, are nothing else but dried *Mucilages*. Or, if we will take the word in its widest sense, then all *Gums* are originally, either a *Turpentine*, or a *Milk*, or a *Mucilage*.

I HAVE made many other Observations of the *tastes*, *smells*, and *colours* of *plants*, and of their *contents*, since those I last published: and that both for the finding out the true *causes* of their *generation*, and also the applying of them unto *Medical use*. As also to *Mechanical*; and particularly the making all sorts of *Paints*, or *Tinctures* out of the several *parts* of *Plants*, for *drawing* in *Water-colours*. In the choice whereof there is much difference to be made. For there are many *Plants* whose *Colours* are very clear and radiant, in the *Plants* themselves; yet when they come to be used, will not hold, but change and and grow *foul*. But these things, because they belong more properly to the *Flower*, and other *parts* of *Plants*, I therefore omit, till if *God* give me life and health, I come hereafter to speak of those *parts*.

And that I might the more fully inform my self and others in these matters; it may be thought requisite, that all kind of exotic parts of *Plants*, as well as those growing amongst us, should likewise be examined. For the procuring whereof, both from the *East* and *West Indies*, I have already bespoke the care of some Persons. To whom I have likewise given direction, how to preserve them in such sort, as that

I may have them fresh, as if they were newly taken from the *Plant* or *Tree*. And thus far of the *Generation of Liquors*.

CHAP. V.

THE *Fifth Head*, shall be, of the *figuration of Trunks*. Which also, as well as the *making of liquors* dependeth upon the *structure of the Parts*. As *first*, almost all *shrubs* (*ceteris paribus*) have a greater number of *Air-vessels*; and those of a smaller size; and consequently much spread abroad, as most easily yielding to the *magnetick power of the air*, according as we have more fully demonstrated, in speaking of the *Vegetation of Roots*: as in *Elder, Hazel, Fig, Sumach*, and the like. By which spreading, the said *Air-vessels* do sooner, and more easily strike into the *Bark*, and so produce *collateral Buds and Branches*, and that upon the first rising of the *Body* from the *Root*: that is, the *Plant* becomes a *shrub*.

BUT if the said *Air-vessels* are very large, they will not yield so easily to shoot out collaterally; and so the *Trunk* grows up taller and more entire: as in *Oak, Walnut,*

Ch. 5. of Trunks. 69

Wallnut, Elm, &c. wherein they are exceeding large, is seen. Hence also the *Vine*, if it be but supported, will grow to a prodigious height. And *Hops* and *Bryony*, are some of the tallest, amongst all *Annual* growths: the *Air-vessels* of all which are very large. Whereas *Borage*, and other like *Plants*, although the *pores* of their *parenchyma*, are vastly wide, and filled with *sap*; yet because their *Air-vessels* are small, they are therefore but *dwarf* plants. Wherefore the tallness or advancement of a *Plant* or *Tree*, dependeth not upon the plenty of *Sap*, how great soever, but on the largeness of the *Air-vessels*.

Again, as a *Plant* or *Tree* grows either *shrubby*, or *Tall*, according to the size of the said *Vessels*: so from their *position*, doth it grow *slender* or *thick*. So where they keep more within the compass of a *Ring*, as in *Elm*, and *Ash*, the *Tree* in proportion, usually grows taller and less thick. But where the said *Vessels* are spread more abroad, and especially are postured in *Rays*, as they are in *Oak* the *Tree* grows very thick. Because the said *Vessels* thus standing all along nearer to the *Insertions*, there is a more ready and copious passage of the *Air* out of the one into the other; and so the *Diametral* growth of the *wood* is more promoted.

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Lastly, from the same general cause it is, That the *Trunks* of *Vegetables* are either *Round* or *Angular*. Those of all *Trees* are *round*. Because the *Bark*, being here thicker, and the *Air-vessels* bound up with a greater quantity of *Wood*; the *Air* hath not sufficient power to move them, and the *Bark* with them, into those various positions or figurations, as the *Trunks* of *Plants* yield to.

Yet the cause of the various *shapes* of the *Trunks* is not the *Air* alone; but partly the *principles* of the *Plants* themselves, in conjunction therewith: according to the predomination whereof, as chiefly of some certain kind of *salt* (as I may possibly hereafter more particularly explicate) the *Trunk* is *square*, *triangular*, *pentangular*, or otherwise figured. And thus much in general of the *figuration* of *Trunks*.

C H A P. VI.

THE *Motions* also of *Trunks* are various. Principally *four*; *sc.* *Ascending*, *Descending*, *Horizontal*, and *Spiral*. The cause of the *ascent* of a *Plant*, is a certain *Magnetick* correspondence betwixt the
air

air and the *Air-vessels* of a *Plant*, the *motion* and *tendency* whereof the whole *Plant* follows. This I have asserted, and I think, clearly demonstrated in my first and second *Books* of the *Anatomy of Plants*. I will here add this plain *experiment*.

Take a Box of Moulds, with a hole bored in the bottom, wide enough to admit the *stalk* of a *Plant*, and set it upon stilts half a yard or more above ground. Then lodge in the mould some *Plant*, for example a *Bean*, in such sort, that the *Root* of the *Bean* standing in the moulds may point upwards, the *stalk* towards the ground. As the *Plant* grows, it will follow, that at length the *stalk* will rise upward, and the *Root* on the contrary arch it self downward. Which evidently shews, that it is not sufficient that the *Root* hath *Earth* to shoot into, or that its *motion* was only an *appetite* of being therein lodged, which way soever that be: but that its nature is, though within the *Earth* already, yet to change its *position*, and to *move downwards*. And so likewise of the *Trunk*, though already in the free *air* above ground, yet now to make a new *Motion* upwards.

BUT although the *natural motion* of the *Trunk* be to *ascend*; yet is it forced

oftentimes to *descend*. For the *Trunk-Roots* growing out of some *Plants* near the ground, and striking thereinto, do like so many Ropes, pluck the *Trunk* annually lower and lower into the ground together with them; as may be seen in *Scrophularia*, *Jacobæa*, and many other *Plants*.

IF these *Trunk-roots* break out only about the *bottom* of the *Trunk*, as in the aforesaid *Plants*, then the *Trunk* gradually *descends* into the *earth*, and is turned into a *Root*. But if it be very *slender*, and the *Trunk-roots* break forth *all along* it, then it *creeps* horizontally; the said *Roots* tethering it, as it trails along, to the ground; as in *Strawberry*, *Cinquesoyl*, *Mint*, *Scordium*, &c.

AS to their *Spiral motion*, it is to be noted; That the *Wood* of all *Convolvula's* or *Winders*, standing more close and round together in or near the center, thereby making a round, and slender *Trunk*. To the end, it may be more tractable, to the power of the external *Motor*, what ever that be: and also more secure from breaking by its winding *motion*.

Wherefore, *Convolvula's* do not wind by any peculiar nature or *Genius*, which other *Trunks* have not; but because their *parts* are disposed so, as to render them
 sequa-

seguaceous to the external *Motor*. Even as the *Classpers* of a *Vine*, having the like *Structure*, have also a *motion* of *Convolution*: whereas the *Branches* themselves upon a contrary account, move in a *strait* line.

The *Convolution* of *Trunks*, is made not one, but *divers* ways; some moving by *South* from *East* to *West*; and others from *West* to *East*. Wherefore it seemeth, that as the *efficient* cause of *Convolution*, is not within the *Plant*, but external: so also, that it is not one, but that there are *two* great *efficients* of this *Motion*; sc. the *Sun* and the *Moon*. Some winding together with the *Sun*, in its *Diurnal* motion, by *South* from *East* to *West*. And others winding with the *Moon*, in its *Monthly* motion, from *West* to *East*.

This possibly, may also be one *sensible* way of distinguishing betwixt *Solar*, and *Lunar* *Plants*. Thus far, in general, of the *motions* of *Trunks*.

CHAP. VII.

THE last thing I purposed to speak of, is those several *Qualities* of *Trunks*, or of *Timber*, by which they are fitted for
Mecha-

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Mechanical use. As *hardness, softness, fastness, clevesomeness, toughness, brittleness, durableness*; of any of the same *qualities* compounded. The *visible* causes whereof are observable partly in the *structure* of the several parts; sc. the *Insertions, Sap-vessels, and Air-vessels*; as to the *number, size, or position* of any of them. And partly in the *nature* of the parts; I mean such as is *manifest to sense*. According to our clear and distinct observing of all which causes, we may understand, wherefore any *Wood* is made use of for this or that purpose. And also, wherein fitly to apply it to further use. In order to which, a compleat History of the *Mechanical uses* of *Vegetables* would very much conduce. I shall for the present give some *Instances*.

AS first, some *Woods* are *soft*, as *Deal* and *Sallow*. Yet from different causes. *Deal*, from the great *porosity* of the *Wood* it self, or the large *Pores* amongst the *Sap-vessels*. But *Sallow*, not from the porosity of the true *Wood*, but the great number of *Air-vessels* spread all over it. For the same cause, though they are both *soft*, yet will not serve for the same purposes; *Sallow* being well wrought upon, which way soever you cut it: but *Deal*, especially the white *Deal*, if it be cut cross, it tears, and will

will never polish or work smooth.

Again, in *Sallow*, by the equall spreading of the *Air-vessels*, the *softness* is equal or alike in all parts. For which cause it maketh an excellent *coal* for *Painters Scribets*. Because it doth not only make a *light*, but every where a *certain stroak*, and so doth not disturb the even motion of the hand. For the same cause, *Shoemakers* also make use of it for their *Carving-boards*. Because being every where equally soft, it turns not the *edg* of their *Knives*. Which *Deal* would presently do; because though very soft in some places, yet in others 'tis hard; that is to say, on the inner verge of every annual *Ring of Wood*, where the old *sap-vessels* grow much more compact and close together.

AGAIN, some *Woods* are *soft*, but not *fast*; others are *both*, as *Linn*: its *softness*, depending on the numerousness and equal spreading of the *Air-vessels*: its *fastness*, on the closeness of the true *Wood*, and the shortness, smallness and frequency of the *Insertions*. For which cause, it is of excellent use for many purposes; and particularly, for *small sculpture*: such as may sometimes be seen for the *Frames of Looking Glasses*, or of smaller *Pictures in Water-colours*.

SOME

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SOME Woods, again, are *fast* and *hard*, as *Elm*. Its *hardness* depending upon the closeness of the true *Wood*. Its *fastness* partly upon the same cause, partly on the smallness of the *Insertions*, partly on the fewness of the *Air-vessels* in proportion with the *Wood*, and partly the thwart and *cross position* of many of them. Hence it is, that *Elm*, of all others, is the most *cross-grain'd Timber*; that is, cleaveth so unevenly, to and fro, according to the *cross position* of the said *Vessels*.

Hence also it cleaveth the *most difficultly*. Even then, when it is without any *knots*. For which reason it is always used, as best, for the *Hub* of a great *Wheel*. As also for *Water-pipes*, and for *Pumps*. Not because it is the most *durable wood*; but because it will not *splitt* or crack either in the *working*, or *afterwards*. For the very same reason, it is used for *Coffins*; that is, because it will not *splitt* in *working*: not because it will endure longest under ground; for *Pales* are always made of *Oak*. So also the *Ladles* and *Soles* of a *Mill-wheel* are made of *Elm*; as also the *Keel* of a *Boat*, *sc.* least they should *splitt*: but the other parts are made of *Oak*.

ON THE contrary as *Elm*, of all woods, is one of the *fastest*; So of all *hard woods*,
Oak

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Oak is the most *Cleavesome*, or *splitteth* the most *easily*. The cause whereof is, partly the largeness of the *Insertions*, and partly the *diametral* or radiated *position* of most of the *Air-vessels*: upon both which accounts, wherever a *crack* is begun 'tis easily continued throughout the *Diameter* of the *Trunk*.

AGAIN, some *Woods* are *hard*, *fast*, and *tough*. So is *Ash*, and especially *Beech*. *Hard* and *fast*, from some of the same causes, as *Elm*. *Tough* not from the *structure*, but from the *nature* of the *parts*; viz. as being a less *cylie Wood*, and so not *Brittle*. Wherefore *London-Cars* have the *Rings* of their *Wheels* of *Beech*; because it *tears* more difficultly than even *Ash* it self. Whence also for *large screws*, there is no *Wood* like it. But for *small screws*, of about an *Inch diameter*, *Birch* is the best; as being, though not so *hard*, yet more *tough*.

THE more *Brittle* a *Wood* is, 'tis likewise usually the most *durable*. So *Oak*, which is not a *tough*, but very *brittle wood*, is almost as *durable* as any. Whereas *Beech*, *Birch*, and the like, although very *tough*; yet for *duration*, are of no service; for there are no *Woods* will rot sooner: and therefore, though strong enough, yet unfit to make any standing parts of *Building* or of *Furniture*;

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ture; especially in wet and moist places. Because, being as is said, *unoylie woods*, they are apter to imbibe the moisture even of a *dank Air*; by which moisture, they either rot or breed *worms*, which destroy them.

HENCE it is, that what we call the *Heart of Timber*, as it is more *brittle*, so also more *durable*; *sc.* Because more *oylie*. So that which is called the *Sap of Oak*, is much more *tough* than the *Heart*; although the *Heart* be more *durable*. That is to say, the older the *Wood* is, the *watery* parts are the more evaporated, the *oylie* still remaining, as a kind of *Tincture* in the *Wood*. Even as we see, that the older *Seeds* of the same *kind*, are more *oylie* than those that are green and young. So that the *oylie* or *rosinous* parts of the *Sap*, are a kind of *Embalming* to the *Heart*, or older part of a *Tree*, securing it from the destructive impressions of the *Air*. For the same cause it is, that *Oak*, *Yew*, *Cocus*, *Guajacum*, &c. Which are *oylie woods*, have always much *Heart*: whereas *Birch*, *Alder*, *Beech*, *Maple*, which are very *unoylie*, have never any *Heart*.

FROM hence likewise we may understand the cause of the *toughness* of *Flax*: what we call *Flax*, being only the *sap-vessels* of

of the *Bark*. And generally, the *Bark* of any *Tree*, as of *Willow* (whereof are usually made a sort of *Ropes*) is very *tough*. The *Vessels* being here younger, and less *oylie* than in the *Wood*. So likewise *Hemp*, is nothing else but the *Sap-vessels* of the *Bark* of the *Plant* so called. And *Scotch-cloath*, is only the *Houssemisry* of the same *parts* of the *Bark* of *Nettle*.

WHENCE it is very probable, that there are many other *Plants*, as well as the above named, whereof might be made good *Toe*. And of some, especially in some respects, better than of *Flax* it self. Because that even *Hemp*, although it will not make so fine a *Staple*, as *Flax* (for all our fine *Hollands* are made of *Flax*) yet *Flax*, which is but of the same fineness as *Hemp*, will never, by all the art yet known, be made so white as *Hemp* is made. The *qualities* therefore of the best *Toe*, that can be in nature, are that the *Staple* be long, small, tough, and white. So that if in the *Bark* of any *Plant*, we can find these *qualities* to excell, we may be sure it will be of better use, in some respects, for the making of *Cloath* than *Flax* it self.

I WILL conclude with one *Instance* more, & that is as to *Grafting*. The good and happy success whereof, doth certainly depend

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depend upon the suitableness or response betwixt the several parts of the *stock* and *Cyon*; as the *Bark*, *Wood*, and *Pith*: and that both as to the *number*, *size*, and *position* of the said parts, and of their several *Pores* or *Vessels*: according to the degrees whereof, the *Conjunction* (*cateris paribus*) will be more or less prosperous. So that of all such *Conjunctions* as are found to be apt and taking, and which some have learned not without long practice and experience; another, only by comparing the *Branthes* of *Trees* together, may with little trouble, and in much less time, inform himself. By the same means, some *Conjunctions* which seem to be strange, as *Quince* and *Pear*, *White-thorn* and *Medlar*, &c. do yet, by the response of their parts, as well as by experience, appear to be good. And there is no doubt, but that many *Conjunctions* not yet tryed, or not known to have been so, may upon the same ground, be tryed with good success.

The chief use of *Grafting* and *Inoculation*, is that they accelerate the growth of good fruit. The cause whereof, is the *knot*, which is always made in the *Conjunction*. By means whereof all the *Sap* is strained, and so ascendeth up into the *Graff* or *Bud*,
 purer

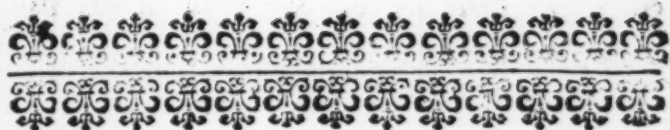
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*pur*er and in less *quantity*; and is therefore better and sooner concocted. Hence, the smaller the *Fruit* of any *Tree*, though it be not the best, yet the *Sap* being there in less *quantity*, is the sooner ripe. On the contrary, where the *Sap* ascendeth too freely, it doth not only retard the growth of the *Fruit*, but produceth *Barrenness*; as is seen in those luxuriant *Branches*, where it runs all up to *Leaves*. Hence also *Vines*, by *Bleeding*, become more fruitful: that is, by the effusion of part of the *Sap*, there is a more easy *melioration* of that which remains. Even as *Phlebotomy* doth oftentimes produce a more healthful and better *habit* of our own *Bodies*. To conclude, the lessening the quantity, and thereby the melioration of the ascending *Sap*, by *knots*, is *Natures* own contrivance; as is seen in *Sugar cane*, *Corn*, and other *Plants*.

G

THE

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THE
EXPLICATION
OF THE
FIGURES.

THE Trunks of several Plants, as they appear to the naked eye, upon a transverse Section, represented by the Six first Figures.

Fig. I. Representeth the Trunk of Borage.

aaa. The skin.

ccc. The Bark.

The black line betwixt ccc. ooo. representeth a Ring of Sap-Vessels on the inner verge of the Bark.

ce. One of the larger Parcels of Air-Vessels, adjacent to the said Ring of Sap-Vessels.

co. Some of the lesser Parcels.

The Explication

oco. The Pith wherein the *Visculae* are visible to a naked eye.

t. The hollow of the Pith.

Fig. 2. Representeth the Trunk of *Taraxacum*, or *Dandelion*.

aaa. The Skin.

ccc. The outer part of the Bark, without any Vessels.

In the inner part of the Bark, stand the Sap-Vessels, in several small Rings from ccc. to the thick Ring next to u.

The thick Ring consisteth of Air-Vessels.

u. The Pith.

eucu. The Diametral Portions of the Bark, running betwixt all the Vessels into the Pith.

Fig. 3. Representeth the Trunk of *Colewort*.

aaa. The Skin.

ccc. The outer part of the Bark, having only a very few Sap-Vessels.

The white arched or escalloped Ring, is simply Parenchymous: from whence many small Diametral portions run into the Pith.

The black Ring betwixt ccece. consisteth of Sap-Vessels, and is the true inner edge of the Bark.

All the little black half Ovals without the said Ring, and their to contiguous, are another kind of Sap-Vessels.

All

of the Figures.

All the half Ovals and wedged Parcels within the said Ring, and thereto contiguous, are more Sap-Vessels of the same kind.

The white spots within the several Parcels of Sap-Vessels in the Bark are Parenchymous.

The other white spots within the black Ring of Sap-Vessels, and thereto adjacent, are Air-Vessels.

eee. The Pith.

Fig. 4. Representeth the Trunk of Holy-oak.

aaa. The Skin.

ccc. The outer and larger part of the Bark, without any Vessels.

The Ring betwixt cecce. consisteth of Sap-Vessels, and maketh the inner verge of the Bark.

The short Rays without the said Ring, and thereto adjacent, but not contiguous, are other Sap-Vessels, containing a Mucilage.

The short Rays within the said Ring, and in like manner adjacent thereto, are the Air-Vessels.

The crooked lines or chords e. hemming in the said Air-Vessels are more Sap-Vessels.

eee. The Pith.

t. The hollow of the Pith.

Fig. 5. Representeth the Trunk of wild Cucumer.

The Explication

aaa. *The Skin.*

acacac. *A Radiated Ring of Sap-Vessels adjacent to the skin.*

ccc. *The middle part of the Bark without any Vessels.*

The Ring of black spots betwixt cecece. are other Sap-Vessels standing in the inner verge of the Bark.

The Ring of white spots betwixt cecece. are the Air-Vessels.

The black spots within the Pith, and contiguous to the Air Vessels are other Sap-Vessels, answerable to those in the inner verge of the Bark.

eee. *The Pith.*

Fig. 6. *Representeth the Trunk of Endive.*

aaa. *The Skin.*

ccc. *The outer part of the Bark without any Vessels, or simply parenchymons.*

cecece. *A thick, black, and undulated Ring of Lymphæducts standing in the inner verge of the Bark.*

The black Rays and half Ovals without the said Ring, are other Lymphæducts.

The white Rays, and the white undulated Ring adjacent to ccc. consist of Milk-Vessels.

The short Rays within the black undulated Ring and thereto adjacent, are Air-vessels.

The

of the Figures.

The black specks adjacent to eee. are more Sap-Vessels.

eee. The Pith.

t. The hollow of the Pith.

All the Figures following are Microscopical.

Fig. 7. *A small part of the Skin of the better sort of walking Cane, as it appears through a good Microscope; the black spots representing the ample Pores therein.*

Fig. 8. *Representeth a quarter of a slice of a Branch of Holly of three years growth, cut transversely.*

ABCD. *The Bark.*

AB. *The Skin of the Bark.*

QQQ. *The outer Parenchyma of the Bark; wherein the Vesiculæ are extraordinary small.*

DOPC. *A Ring of Sap-Vessels in the inner verge of the Bark.*

HI. *Divers round parcels of Sap-Vessels of another kind.*

DCFE. *The Wood.*

DK, KM, ME. *The several annual or Growths of Wood.*

SSSS. *The true Wood; being originally the Sap-Vessels of the Bark.*

XXXX. *The Air-Vessels, posur'd some in entire,*

The Explication

entire, others in broken Rays.

O O. The larger Insertions running through the several annual Rings from the Pith in- to the Bark.

O P. The smaller Insertions.

E F G. The Pith wherein the Vesiculæ are exceeding small.

Fig. 9. Representeth a quarter of a slice of a Branch of Hazel of 3 years growth, cut transversely.

A B C D. The Bark.

Q Q. The Parenchyma : wherein the Vesiculæ are larger than those in the Bark of Holly.

H I. A Ring of Sap-Vessels.

D Q C. Divers Parcels of Sap-Vessels of another kind.

D C F E. The Wood.

D L, K N, M F. The several annual growths or Rings of Wood.

S S S. The true Wood.

X X X. The Air-vessels, being most of them very small, and postured in Columns and Rays.

O O. The larger Insertions running through the several Annual Rings from the Pith in- to the Bark.

O P. The smaller Insertions.

E F G. The Pith : wherein the Vesiculæ are much larger, than in the Pith of Holly.

Fig.

of the Figures.

Fig. 10. Representeth a quarter of a slice of a Branch of Barbery Tree of 2 years growth, cut transversly.

A B C D. The Bark.

A B. The Skin.

N M N M. The Parenchyma of the Bark.

D C. A Ring of Sap-Vessels, consisting of large half Oval Parcels.

M O. One of the said Parcels.

H I. An entire Ring of Sap-Vessels of another kind.

D C F E. The Wood.

D L, K F. The several Rings or annual growths of Wood.

S S S. The true Wood.

O P O P. One kind of Air-Vessels, small, and of various position.

P Q P Q. The other kind of Air-Vessels, larger, and postured in clusters more even within a Ring.

M T M T M T. Large Insertions running through the 2 annual Rings from the Pith into the Bark.

E F G. The Pith which is very large.

T T T. A Ring of Sap-Vessels, in the utmost verge of the Pith.

Fig. 11. Representeth a quarter of a slice of a Branch of Apple Tree of 3 years growth, cut transversly.

A B C D.

The Explication

ABCD. *The Bark.*

PP. *The Parenchyma.*

HI. *One kind of Sap-Vessels, standing as it were in a Ring, the utmost in larger oblong parcels, and more distant; the inmost in lesser Parcels, almost halfoval, and closer together.*

DOC. *A thick radiated Ring of Sap-Vessels of another kind.*

DCFE. *The Wood.*

DL, KN, MF. *The several annual Rings of Wood.*

SSS. *The true Wood.*

XT, TV, VW. *The Air-Vessels, being small, numerous, and spread abroad throughout the Wood, without any certain posture.*

O o. *Many small Insertions running through the several annual Rings from the Pith into the Bark.*

EFG. *The Pith.*

WYZ. *The several Insertions arched together in the utmost verge of the Pith, in the like manner as in Barberry, &c.*

Fig. 12. *Representeth a quarter of a slice of a Branch of Pear tree of 3 years growth, cut transversely.*

ABCD. *The Bark.*

R Q. *The outer and more simple Parenchyma, composed*

of the Figures.

composed of very small Vesiculae.

HI. *One sort of Sap vessels distributed through the said Parenchyma in divers oblong parcels. Whereof, those toward the inner verge of the Bark are rounder and more numerous.*

DO PC. *A Ring of Sap-vessels of another, viz. the general kind.*

DCFE. *The Wood.*

DL, KN, MF. *The several annual rings of Wood.*

TTTT. *The true Wood.*

STSTST. *The Air-vessels standing partly irregularly, and partly in rays.*

KL. *A ring of Air-vessels a little larger than the rest.*

O O O. *The larger Insertions running through the several annual rings from the Pith into the Bark.*

OPP. *The smaller Insertions.*

EEG. *The Pith.*

Fig. 13. *Representeth a quarter of a slice of a Branch of Plum-tree of 5 years growth, cut transversly.*

ABCD. *The Bark.*

VW. *The outer and more laxe and simple Parenchyma.*

HI. *One sort of Sap-vessels, postured in small oblong parcels.*

SSS.

The Explication

- SSS.** *The same Vessels more numerous, and in smaller parcels, making a kind of ring.*
- DT C.** *A ring of Sap-vessels of another, viz. the more general kind.*
- DCFE.** *The Wood.*
- DL, LN, &c.** *The several annual rings of Wood.*
- XXX.** *The true Wood.*
- XYXY.** *The Air-vessels.*
- KL, MN, OP, &c.** *So many rings of Air-vessels, (on the inner edge of every ring of wood) much larger than the rest.*
- SSS.** *The great Insertions running through the several rings of wood from the Pith into the Bark.*
- ST T.** *The small Insertions.*
- EFG.** *The Pith.*

Fig. 14. *Representeth a quarter of a slice of a Branch of Elme of 4 years growth and half cut transversly.*

- AADD.** *The Bark.*
- AA.** *The Skin of the Bark.*
- TTTT.** *The Parenchyma of the Bark. Wherein the Vesiculae are so exceeding small, as difficultly to be discerned by the Microscope.*

The black parcels are one kind of Sap-vessels.

- SSD.** *A ring of Sap-vessels of another kind.*
The

of the Figures.

The white Diametral lines, are parenchymous parts continuous with the Insertions S G D G.

DDGE. The Wood.

DK, KM, MO, &c. The several annual rings of Wood.

SSSS. The true wood, being originally the Sap-vessels of the Bark.

KK, MM, &c. The great Air-vessels postured chiefly in rings, on the inner verge of every annual growth of wood.

KM, MO, &c. The small Air-vessels postured chiefly in cross-barrs.

SGDG. Or the small white lines are the Insertions running through the several annual rings from the Pith into the Bark.

E GS. The Pith.

Fig. 15. *Representeth a quarter of a slice of a Branch of Ash of 3 years growth, cut transversly.*

ABCD. The Bark.

AB. The Skin.

AHB. A ring of Sap-Vessels consisting of many round parcels, contiguous to the skin.

HI. The simple Parenchyma.

HOC. A ring of another sort of Sap-vessels, consisting of many arched parcels, all standing off from the Woo.

DCFE. The Wood.

DL,

The Explication

DL, KN, MF. *The 3 annual rings of Wood.*

SSS. *The true Wood.*

STST. *The Air-vessels.*

KL, MN, EF. *The large Air-vessels on the inner verge of every annual ring.*

PQ. *The small Air-vessels spread abroad each ring.*

Ooo. *The Insertions running through the several rings from the Pith into the Bark.*

EF G. *The Pith.*

eee. *The Vesicles whereof the Pith consists.*

Fig. 16. *Representeth a quarter of a slice of a Branch of Walnut-tree of 4 years growth, cut transversely.*

A B C D. *The Bark.*

R R. *The Parenchyma.*

QQ. *The Common Sap-vessels making a ring on the inner verge of the Bark.*

HI. *Other Sap-vessels peculiar to the species, postured in rings, made up of round parcels.*

DCFE. *The Wood.*

DL, KN, &c. *The several annual rings of Wood.*

ddd. *The true wood; or the old Sap vessels, originally on the inner verge of the Bark.*

QcQd. *Other old Sap-vessels which seem to be originally those in the middle of the Bark.*

D C

of the Figures.

D CLK. The Air vessels spread all abroad the whole ring of wood.

ec. A Conjugation of several Air-vessels, standing in an even line close together.

QQQ. The Insertions, running through the several rings of wood, from the Pith into the Bark.

EFG. The Pith.

EF. A ring of Sap-vessels on the verge of the Pith.

Fig. 17. Representeth a quarter of a slice of a Branch of Fig-tree of the second years growth, cut transversly.

ABCD. The Bark.

LM. The outer laxer and more simple parenchyma; wherein the Vesiculæ are somewhat large, yet much lesser than in the pith.

DKC. One sort (viz. the common sort) of Sap vessels, being Lymphæducts.

HI. Another sort of Vessels, viz. the lactiferous, postured in several arched parcels.

NT. The Insertions running in Diametral portions, near half way through the Bark.

DCFE. The Wood.

TTT. The true wood.

TVTV. The Air-vessels.

STSTS. viz. The whiter parts, which were originally the Milk vessels in the Bark.

KKK. The Insertions running through the wood

The Explication

wood from the Pith, as far as the Milk-vessels in the Bark.

EFG. *The Pith: wherein the Vesiculæ are large.*

EF. *A ring of Sap-vessels chiefly lactiferous, postured in round parcels on the edge of the pith.*

Fig. 18. *Representeth a quarter of a slice of a Branch of Pine-tree of the second years growth, cut transversly.*

ABCD. *The Bark.*

AB. *The skin; which is very thick.*

MN. *The outer and laxer Parenchyma; wherein the Vesiculæ are of a mean size.*

DLG. *The inner part of the Parenchyma filled up with a thick ring of Sap-vessels, sc. Lymphæducts.*

HI. *The ample resiniferous or Turpentine-vessels, spread abroad the middle of the Bark.*

DCFE. *The Wood.*

XX. *The ample pores of the true wood.*

SS. *Some small Gum-vessels.*

The Air-vessels are scarcely visible.

LL. *The Insertions.*

EFG. *The Pith; wherein the vesicles are somewhat large.*

VV. *Some Gum-vessels on the edge thereof.*

Fig.

of the Figures.

Fig. 19. Representeth a quarter of a slice of a Branch of Oak of 3 years growth, cut transversly.

ABCD. The Bark.

AB. The skin.

XYXY. The Parenchyma.

DQRC. The common Lymphæducts.

HI. A ring of another sort of Lymphæducts.

KLAI. A third sort of vessels, sc. resiniferous, postured in several round parcels.

DCFE. The Wood.

DN, MP, OF. The several annual rings of Wood.

ZZZZ. The true Wood.

ST, VW. Some of the Vessels originally of the Bark, postured in undulated rings.

MN, OP, EF. The larger Air vessels, on the inner verge of every annual ring.

RzRz. The small Air-vessels postured in columns.

QQQ. The great Insertions running through the several annual rings of wood, from the Pith into the Bark.

QRR. The small Insertions.

EEFG. The Pith: wherein the Vesiculæ are exceeding small.

Fig. 20. Representeth a quarter of a slice of common Sumach of the first years growth, cut transversly.

H

AB

The Explication

ABCD. *The Bark.*

AB. *The Skin.*

aa. *The Hairs; some whereof are sharp, others knobbed at their ends.*

KLCD. *A very thick radiated ring of Lymphæducts.*

KL. *A ring of ample Milk-vessels.*

v. *One of the said Milk-vessels.*

tr. *A close Parenchyma encompassing every Milk-vessel.*

HI. *A ring of a third sort of Sap-Vessels, consisting of arched parcels hemming in the Lacteals,*

tt. *One of the said parcels, consisting of some hundreds of Vessels.*

tw. *A laxer Parenchyma.*

XX. *Another ring of Sap-vessels, which seem to be of a fourth kind.*

DCFE. *The Wood.*

xx. *The true Wood.*

xy. *The Air-vessels.*

MMM. *The Insertions. Most whereof run through the Wood, and half way through the Bark, viz. as far as the Lacteals.*

EFG. *The Pith.*

yy. *A ring of Sap-vessels on the edge of the Pith.*

Fig. 21. *Representeth a quarter of a slice of a Branch of common Wormwood, cut transversly.*

A B

of the Figures.

A B C D. *The Bark.*

M N. *The Parenchyma.*

D C. *The common Lymphæducts, consisting of several large parcels, standing in a ring.*

V. *One of the said parcels.*

K L. *Another sort of Lymphæducts, standing in as many parcels as the former, all of them arched.*

r. *One of the said arched parcels.*

H I. *The Resiniferous, or Gum vessels.*

t. *One of the said Vessels.*

D C F E. *The Wood.*

x. *The true Wood.*

xy. *The Air-vessels.*

ym Mm. *The Insertions running through the Wood, and half through the Bark. Where, as well as in the Pith, they are enarched; thus hemming in both the kinds of Lymphæducts.*

E F G. *The Pith.*

zz. *Some few Gum-vessels on the edge of the Pith.*

Fig. 22. *Representeth part of the Bark of a Lactiferous Plant, pared by the length, and therein the Milk-vessels laid bare.*

A A. *The outer surface of the Bark.*

bbbb. *The Parenchyma.*

cc. *A Milk-vessel cloven down the middle.*

dd. *Another, with a small part thereof cloven off.*

The Explication

- ee. *Another, which is entire.*
- ff. *The places where the said Milk-vessels are braced together.*
- gg. *The terms of 2 other Milk-vessels, where, by reason of their more oblique process, they are cut off.*

Fig. 23. *Representeth a piece of Wood, consisting of Vessels, which were originally the Lymphæducts of the Bark.*

ccc. *Some of the said Lymphæducts, composed of many small lignous Fibers (that is to say of other exquisitely small Vessels) standing together so, as to make a hollow Cylinder; that is, a Lymphæduct.*

eee. *Other of the same Lymphæducts, wherein is shewed the knitting of the said lignous Fibers together by Parenchymous Fibers, which run horizontally.*

aa. *One of the same Vessels shewed torn off towards the end from e to a, whereby the several Fibers, and their connexion, do better appear.*

NB. *That for your more distinct and perspicuous engravement, the said Vessels are here represented more ample than they shew even through the Microscope. Which is done in no other Figure besides.*

Fig. 24. *Representeth a parcel of Air-vessels.*

aa.

of the Figures.

- aa. *A Conjugation of two Air-vessels.*
- cc. *A Conjugation of three Air vessels, of several sizes.*
- bbb. *The places where the said Vessels are braced.*
- tt. *The spiral, and almost horizontal continuation of the Fibers whereof the said Vessels do chiefly, but not wholly consist.*
- tb. *The perpendicular continuation of exceeding small parenchymous Fibers, by which the aforesaid spiral ones are mutually knit together, into a firm and coherent Vessel.*
- ce. *The said spiral Fibers unroaved or drawn out in a couple of Vessels.*

Fig. 25. *Representeth the Westage of the Parenchyma (or of the Insertions) and Vessels.*

- aa. *Several portions of the true Wood, consisting of lignous Fibers, running perpendicularly or by the length of the Tree.*
- bb. *The Insertions; consisting of parenchymous Fibers, running horizontally, or by the diameter of the Tree.*
- cece. *Other portions of the true wood; wherein is shewed the intermixture of the lignous and parenchymous parts; not only portion with portion, as in a b; but even Fiber with Fiber.*
- ce. *The process of the lignous Fibers.*

cc.

The Explication

cc. *The process of the parenchymous.*

Fig. 26. *Representeth a quarter of a slice of the stalk of the lesser common Thistle cut transversely.*

A B C D. *The Bark;*

A B. *The Skin.*

H I. *The Parenchyma.*

A H B. *A sort of Lymphæducts contiguous to the skin.*

ee. *One parcel of the said Lymphæducts.*

D C. *A ring of other Lymphæducts, consisting likewise of several parcels, standing on the inner verge of the Bark.*

aa. *One of the said parcels.*

H C. *A ring of Milk-vessels, consisting of several arched parcels, adjacent to the fore-said Lymphæducts.*

cc. *One of the said parcels.*

D C F E. *The wood, divided into several portions.*

aatt. *One of the said portions.*

vvv. *The true Wood; throughout which the Air-vessels, represented by the larger white rings, are distributed.*

E F G. *The Pith, consisting of very large, and angular bladders: the sides whereof are composed of Fibers stitched together, and running chiefly horizontally; winding in a circular manner, out of one bladder into*

of the Figures.

into another; and so mutually intersecting the several arches of their whole circumference.

T T. *One of the said bladders, or rather one half, the other being cut off. The horizontal Fibers whereof, not being single, but so many threds; there being several Fibers in one Thred.*

SS. *One single Fiber.*

EF. *Other Vessels, both Lymphæducts, and lactiferous, within the wood, or on the verge of the Pith.*

tt. *The Lymphæducts.*

ss. *The lactiferous Vessels.*

stac. *The Insertions running betwixt the several portions of wood, from the Pith into the Bark.*

FINIS.

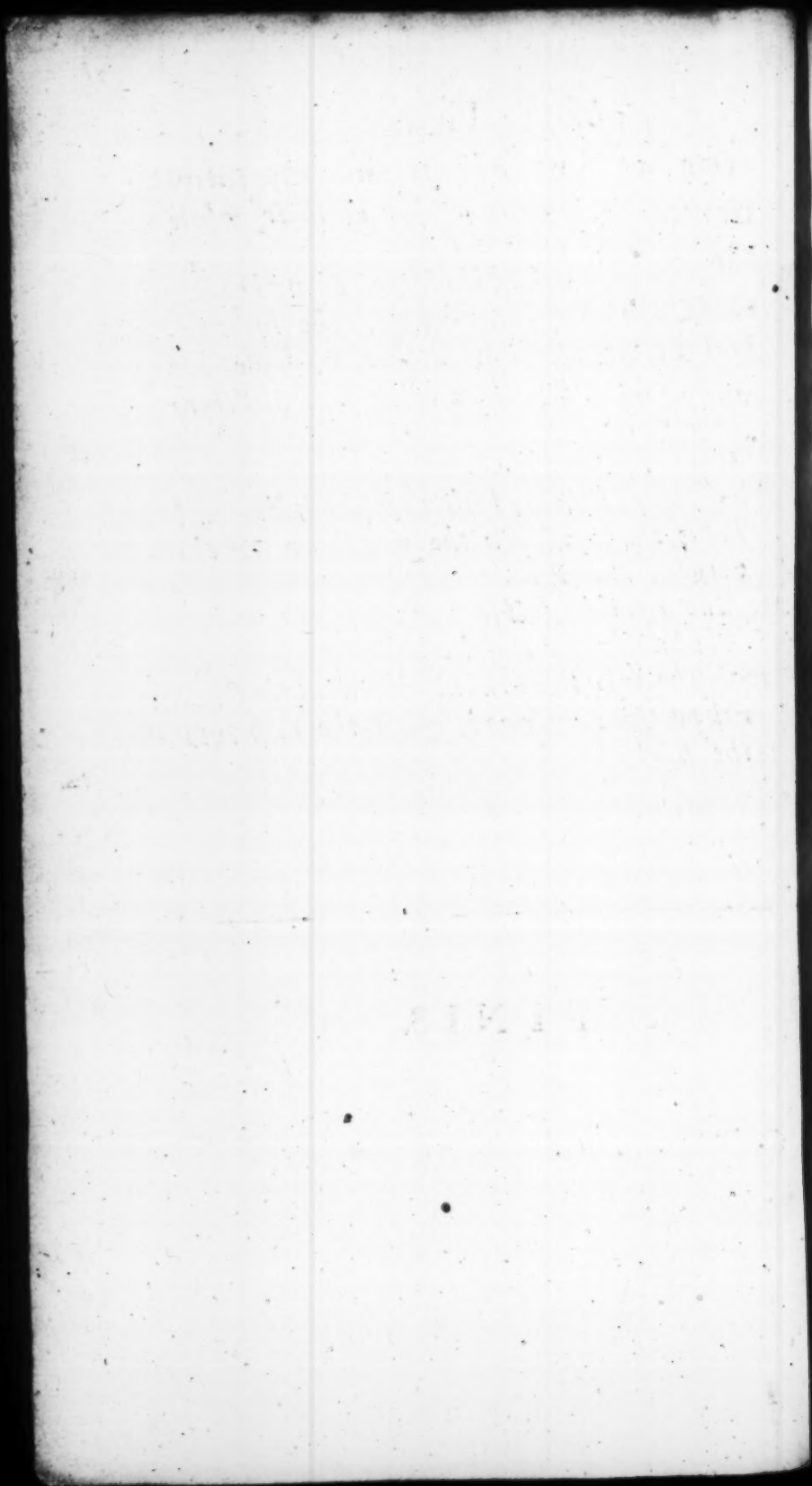


Fig.

Borage



Helyoak



Dandelion



Wild Cucumber



7



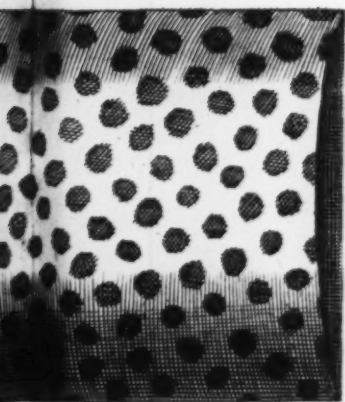
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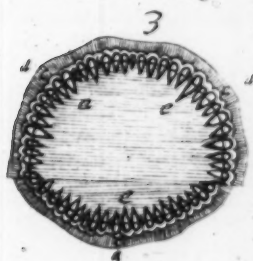
Cucumber



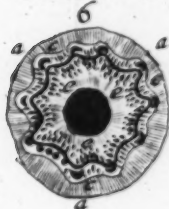
7



Colerwort



Endive





✓

Holly Bush

2

1/2

Holly. Branch.

A

H

D

O

K

M

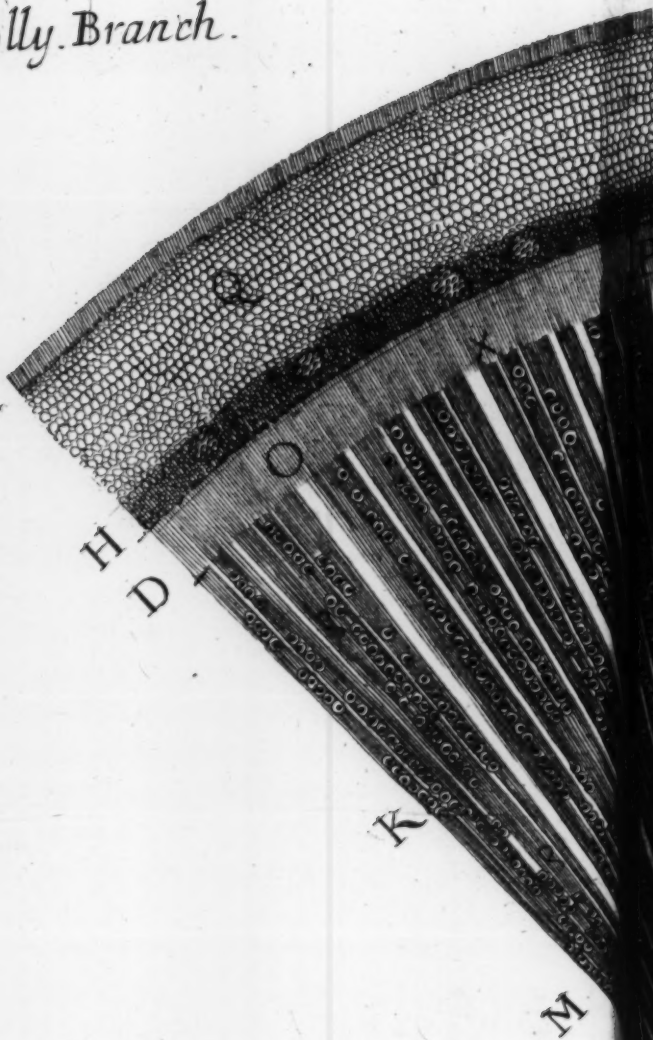
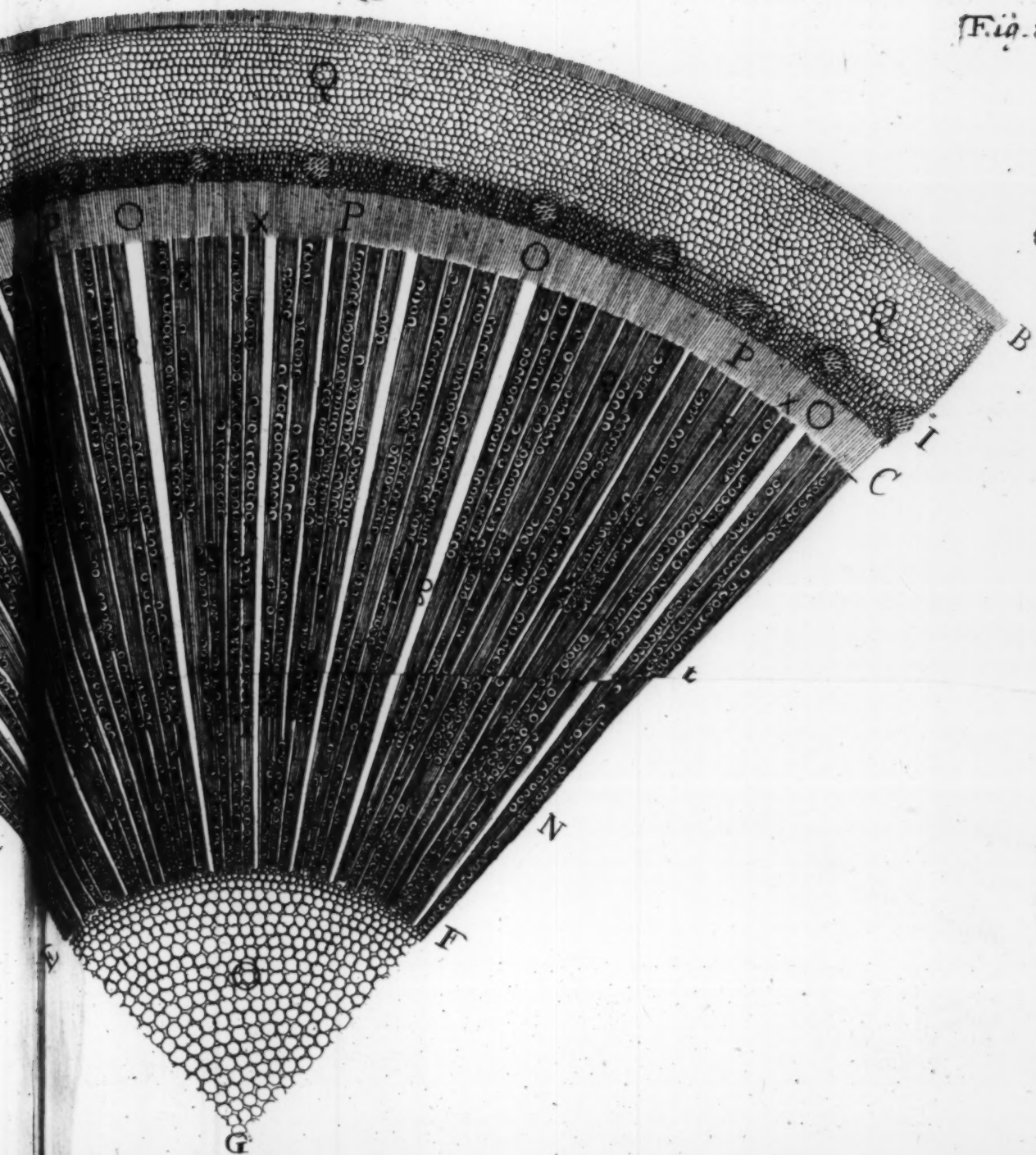


Fig. 8.



Hazel.Branch.

A

H

D

K

M

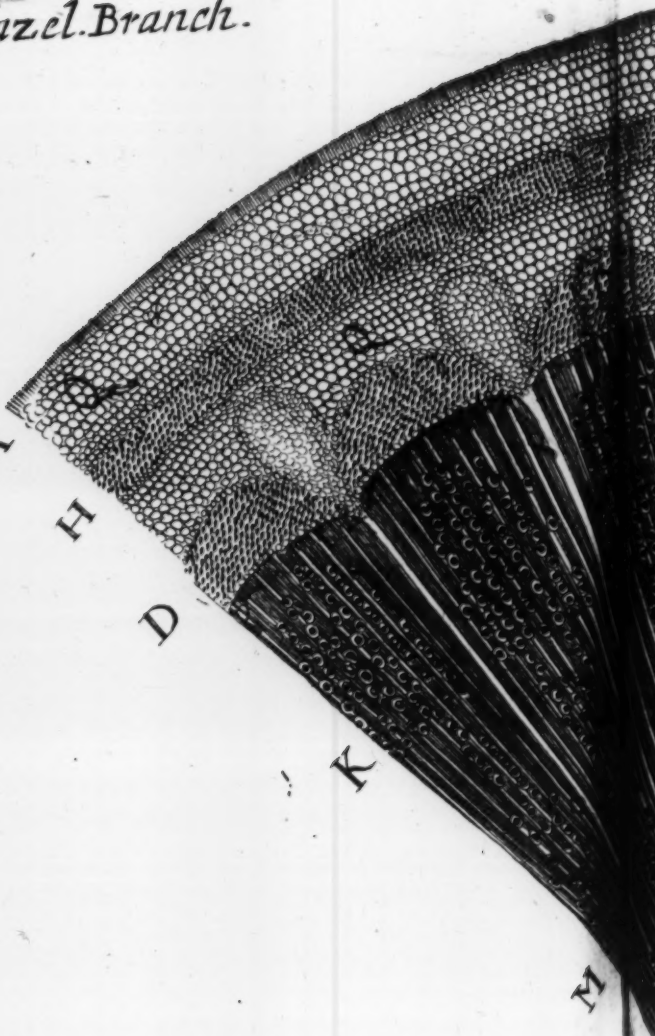
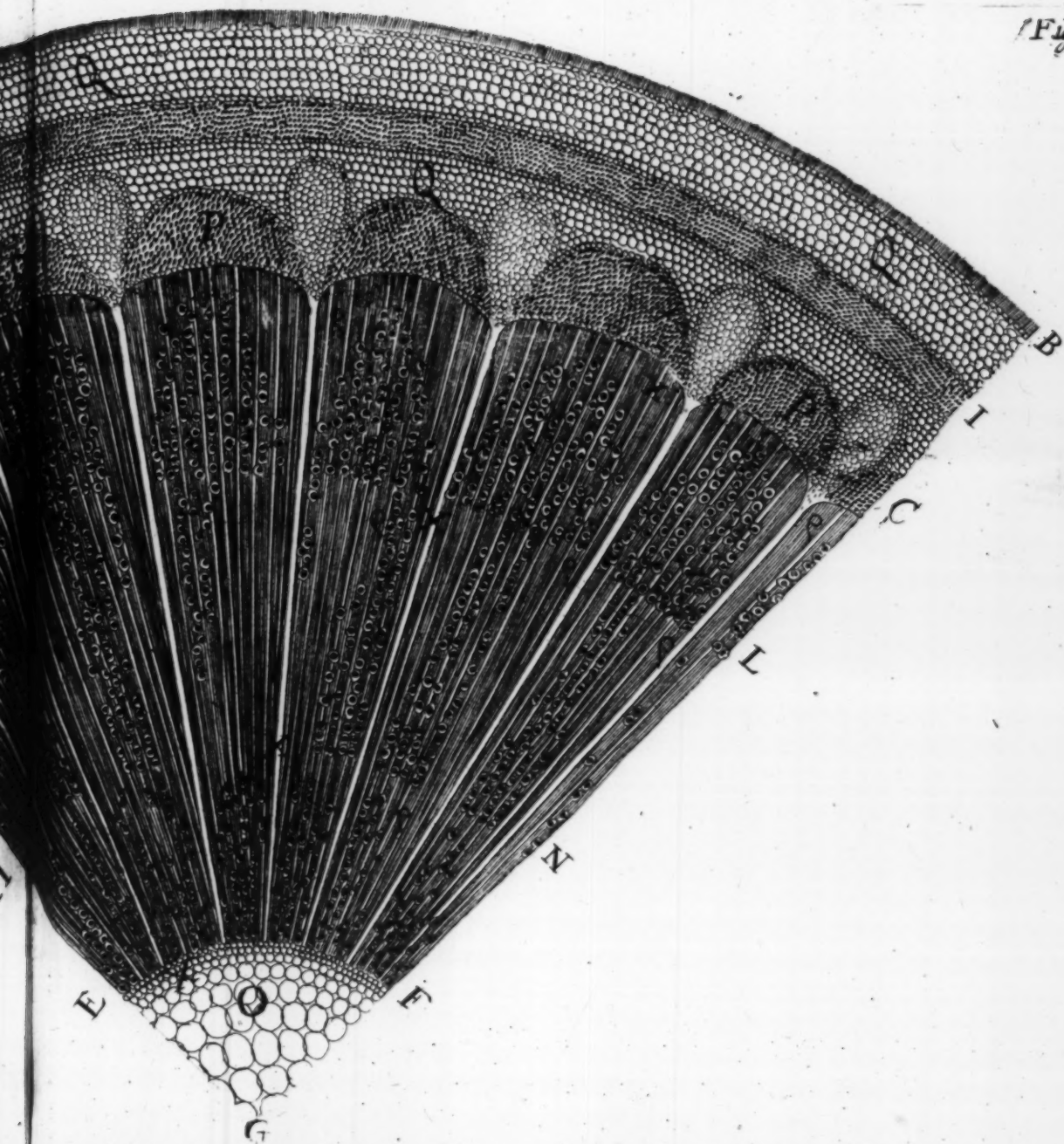
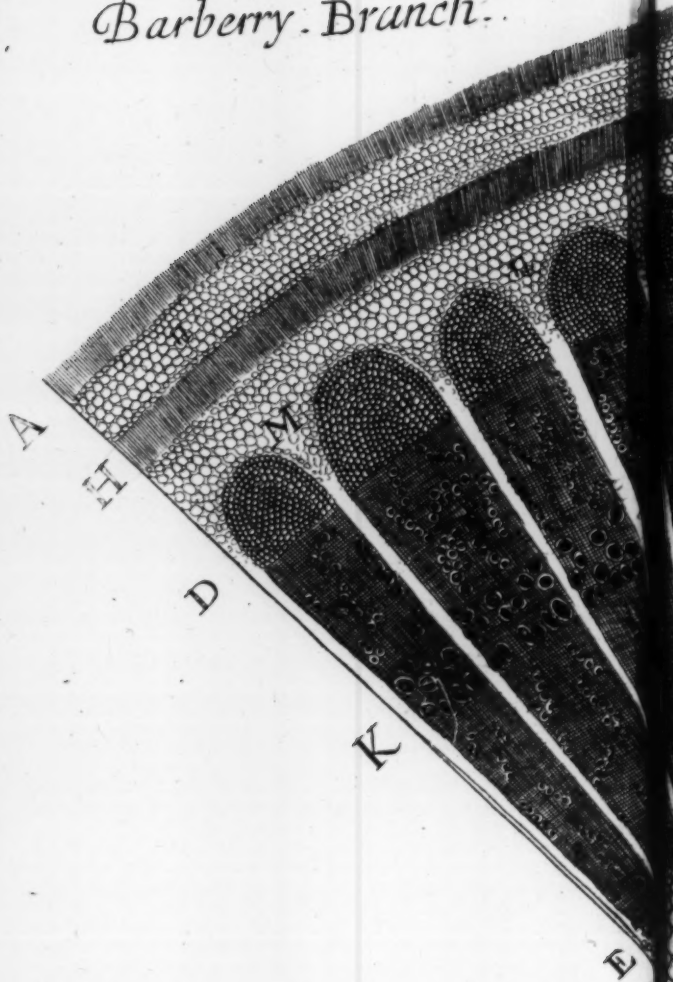


Fig: 9



Barberry. Branch..



Apple. Tree. Branch.

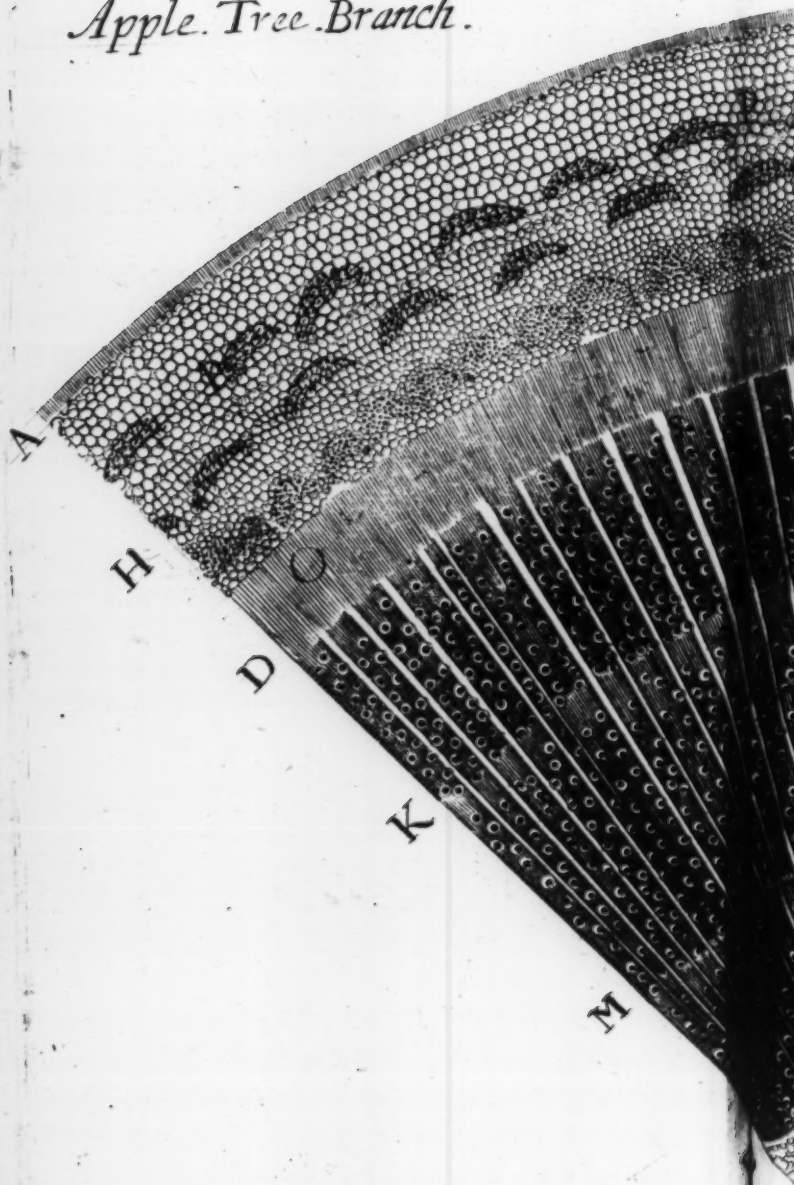
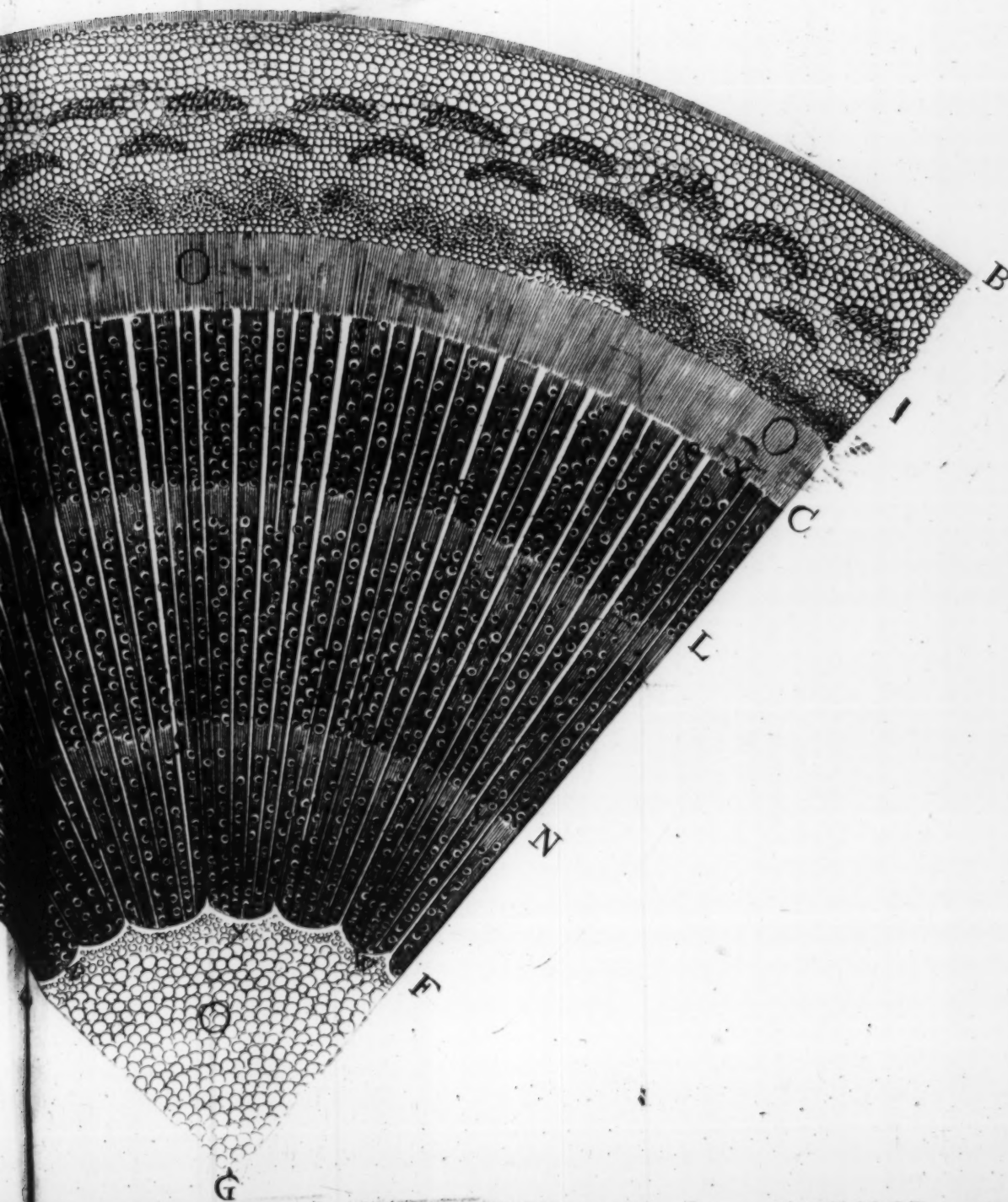


Fig. II.



Pear. Tree. Branch.

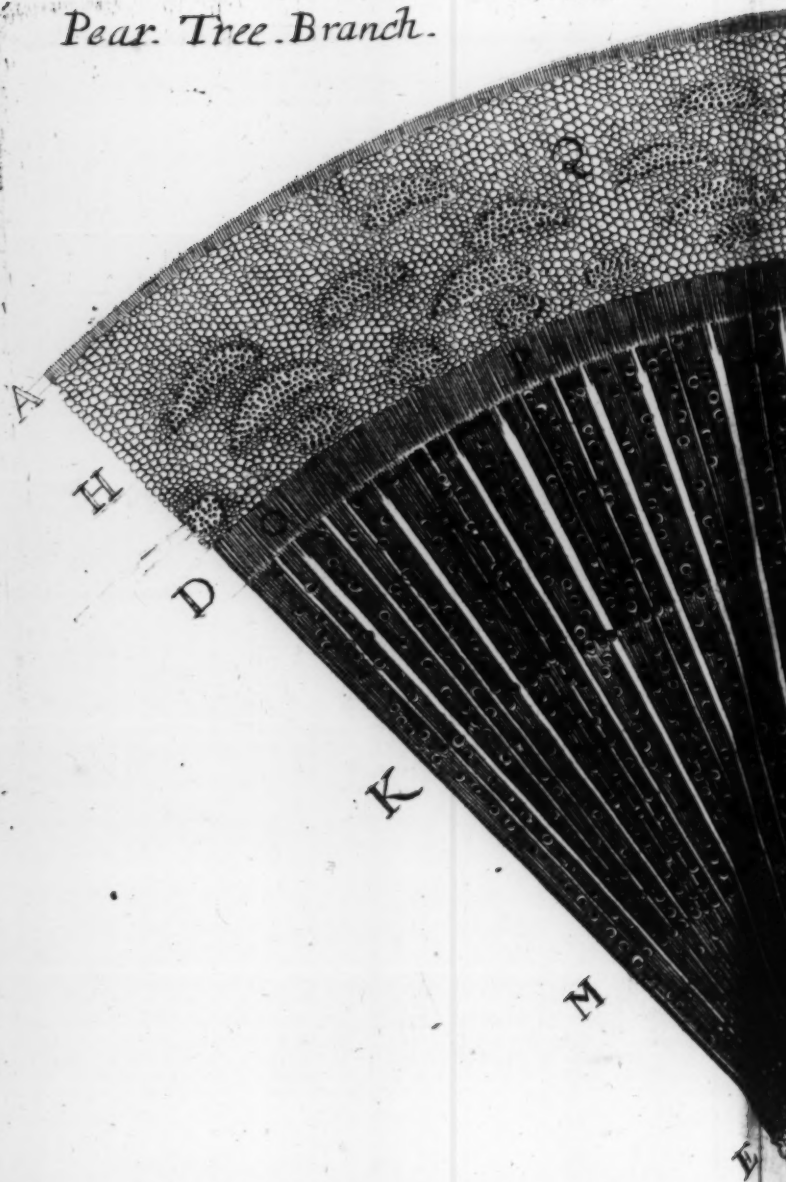
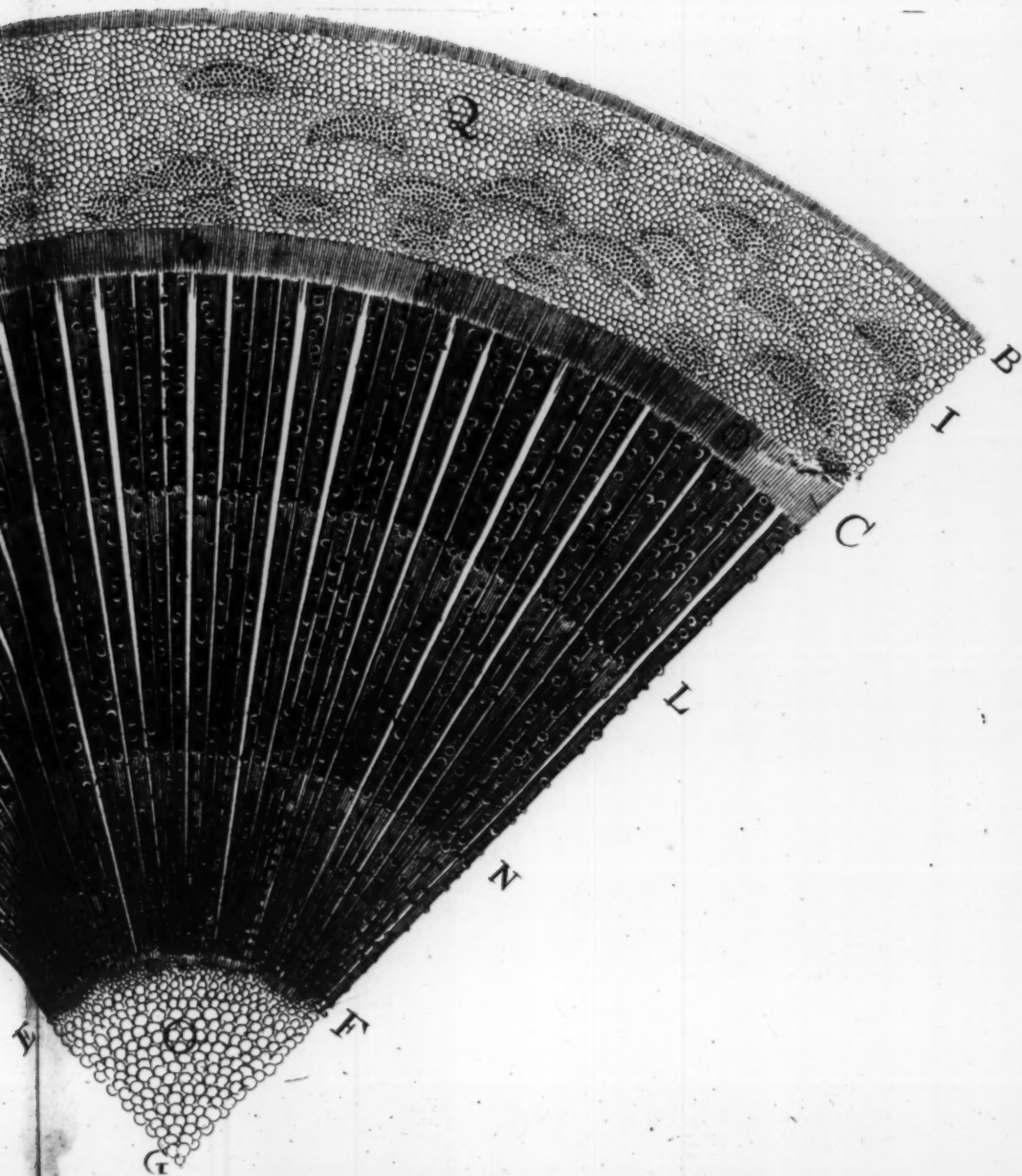


Fig. 12.



Plum. Tree Branch.

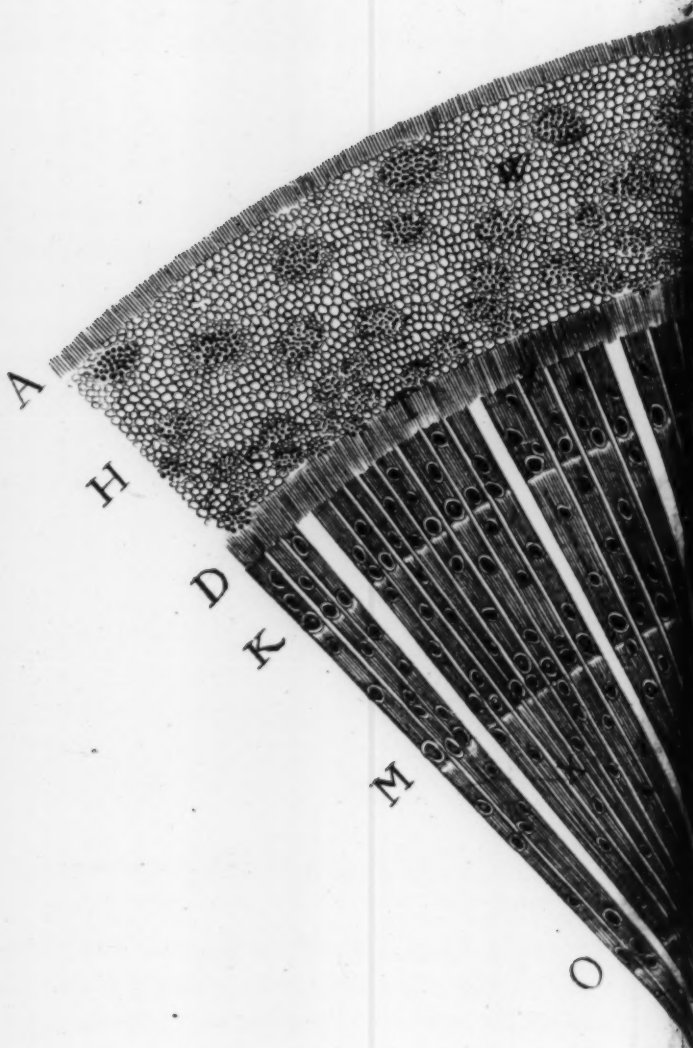
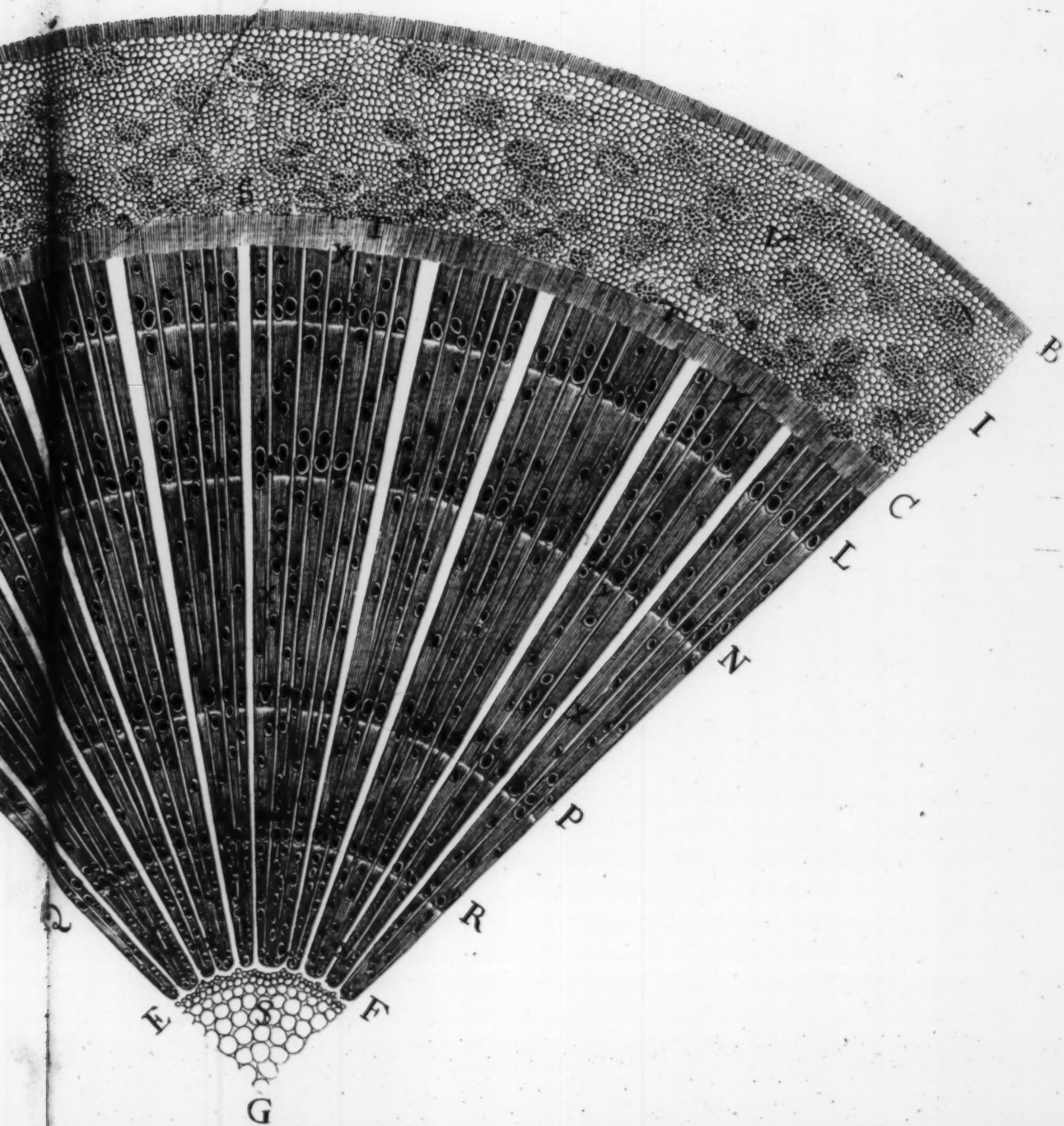


Fig. 13.



Elm Branch.

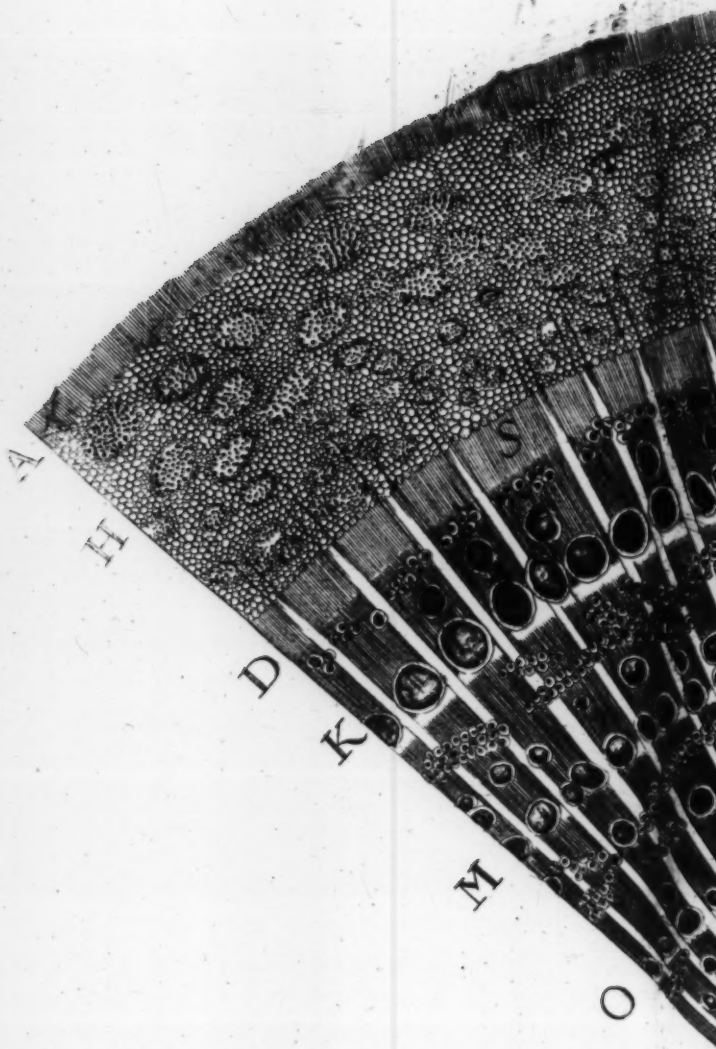
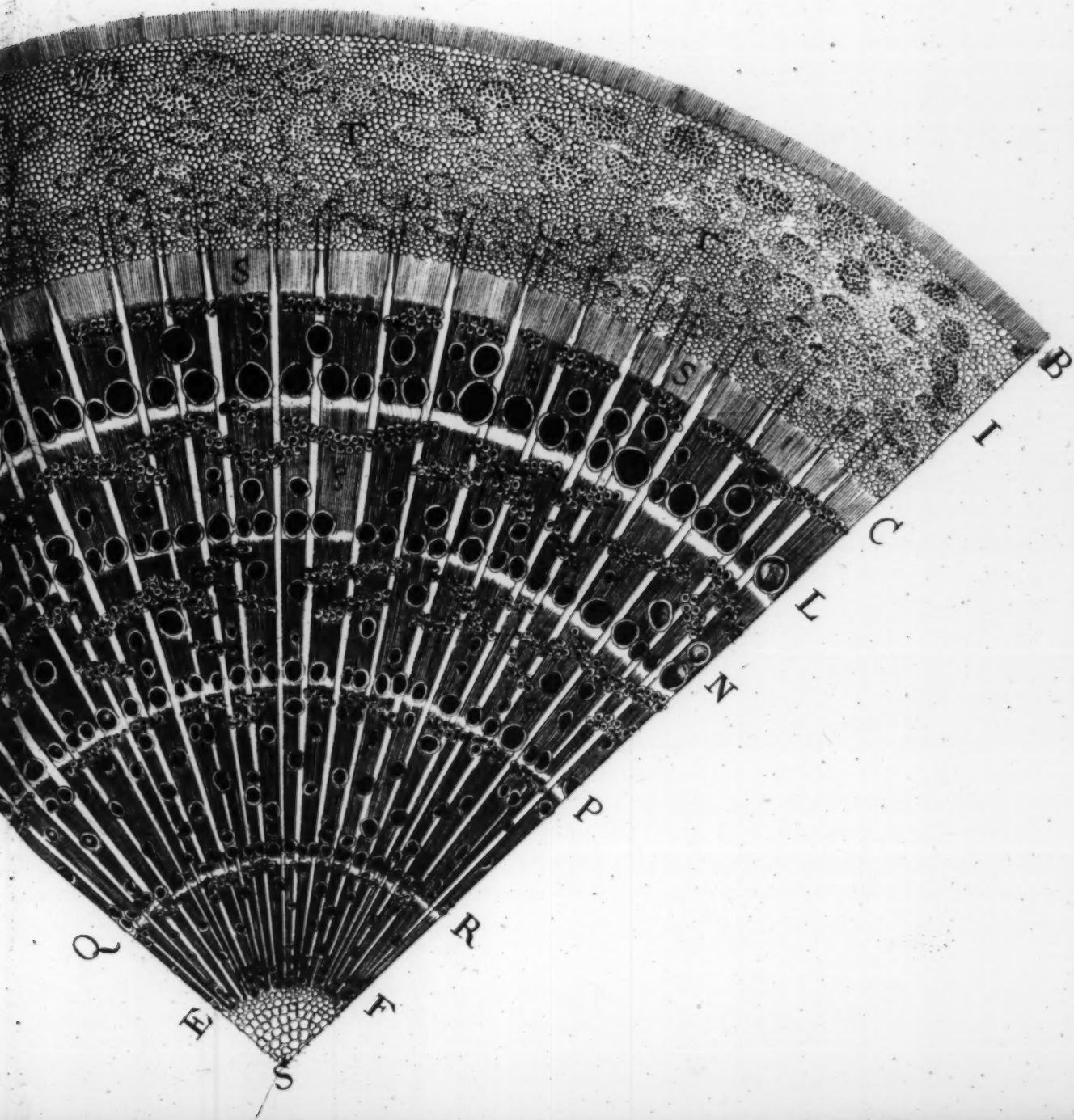


Fig. 14.



Ash. Tree Branch.

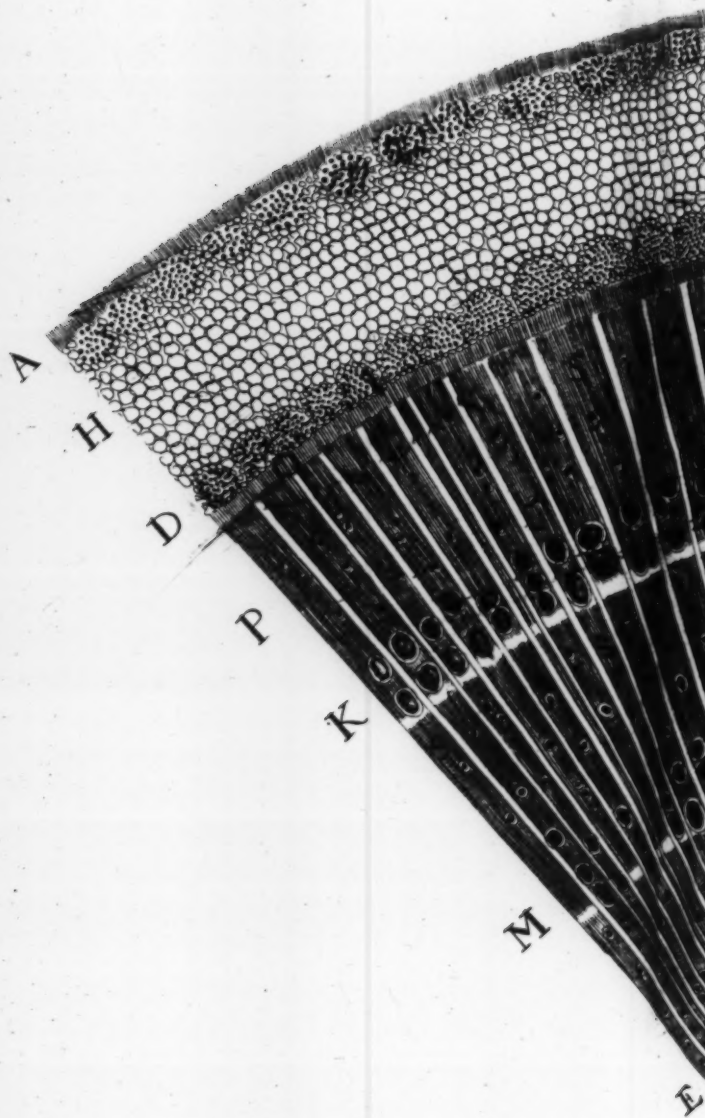
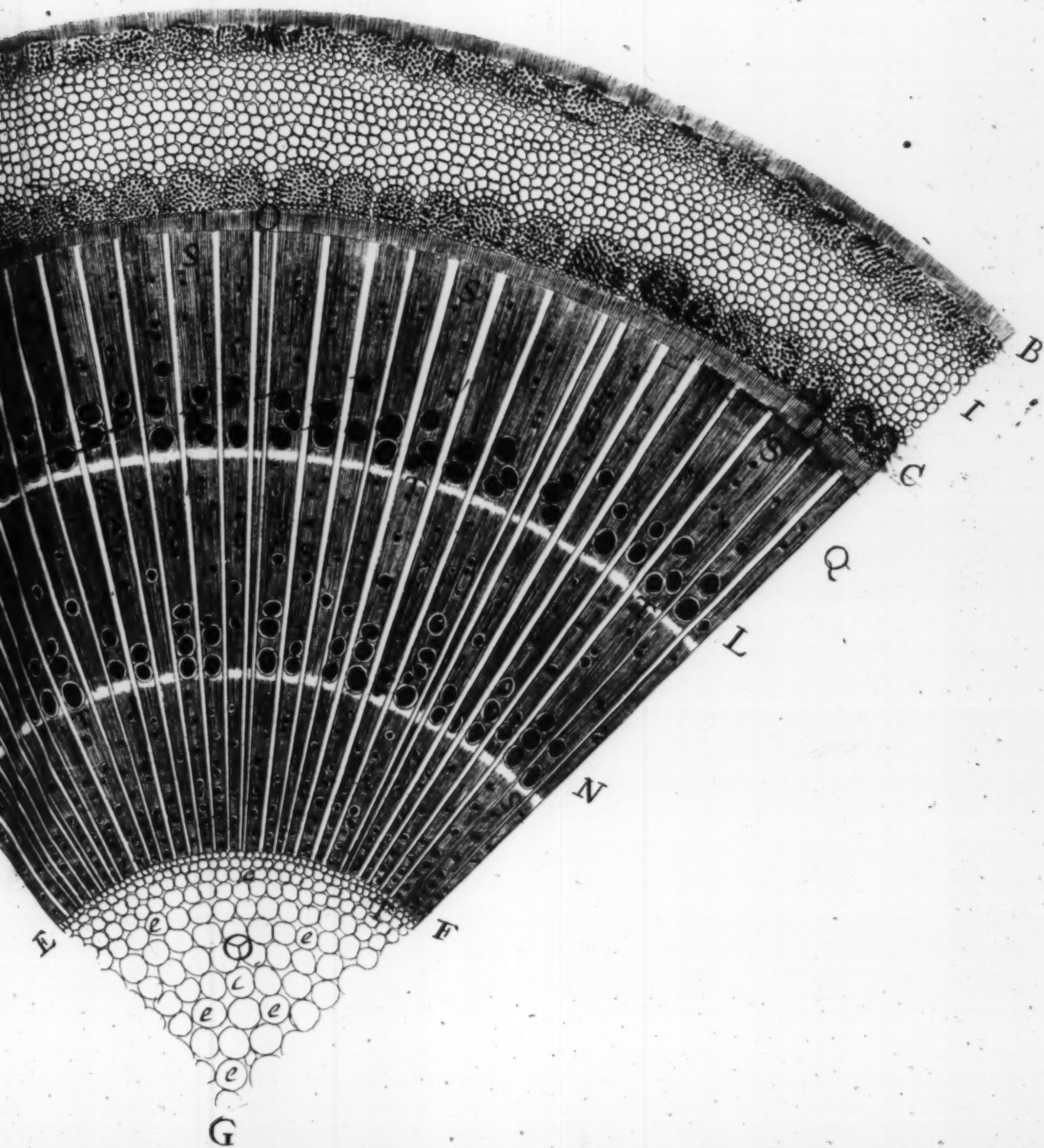


Fig. 15.



Walnut Tree Branch.

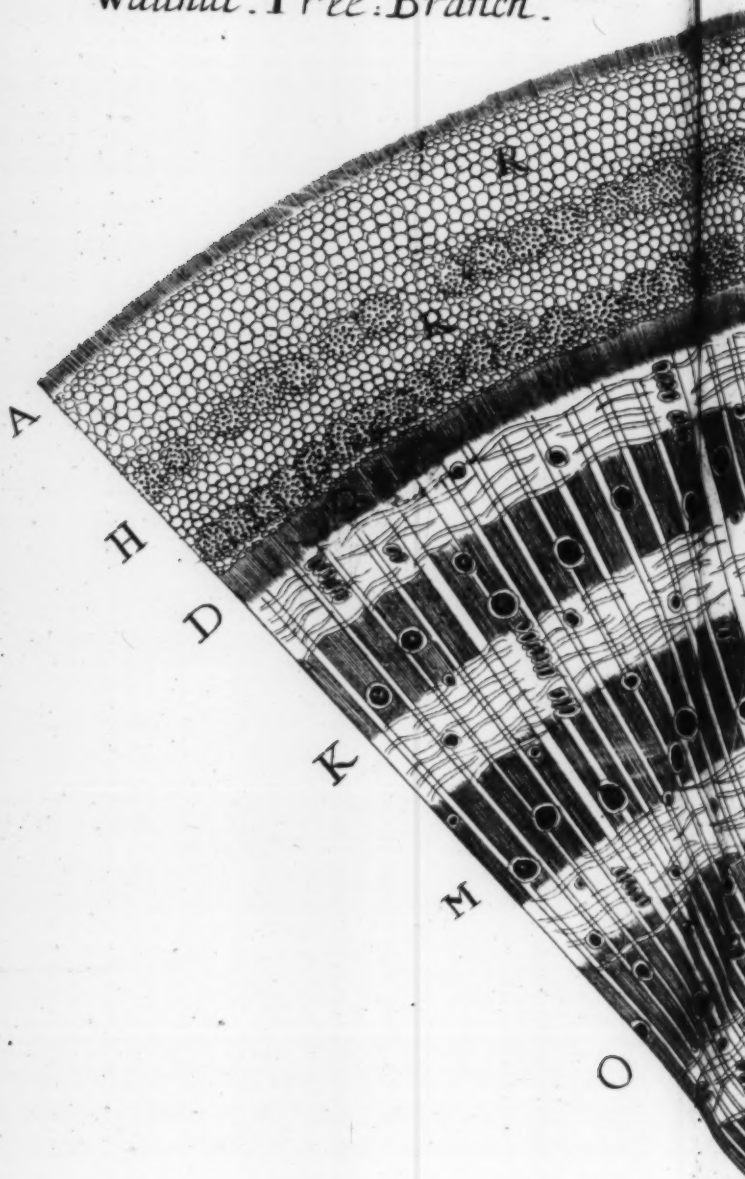
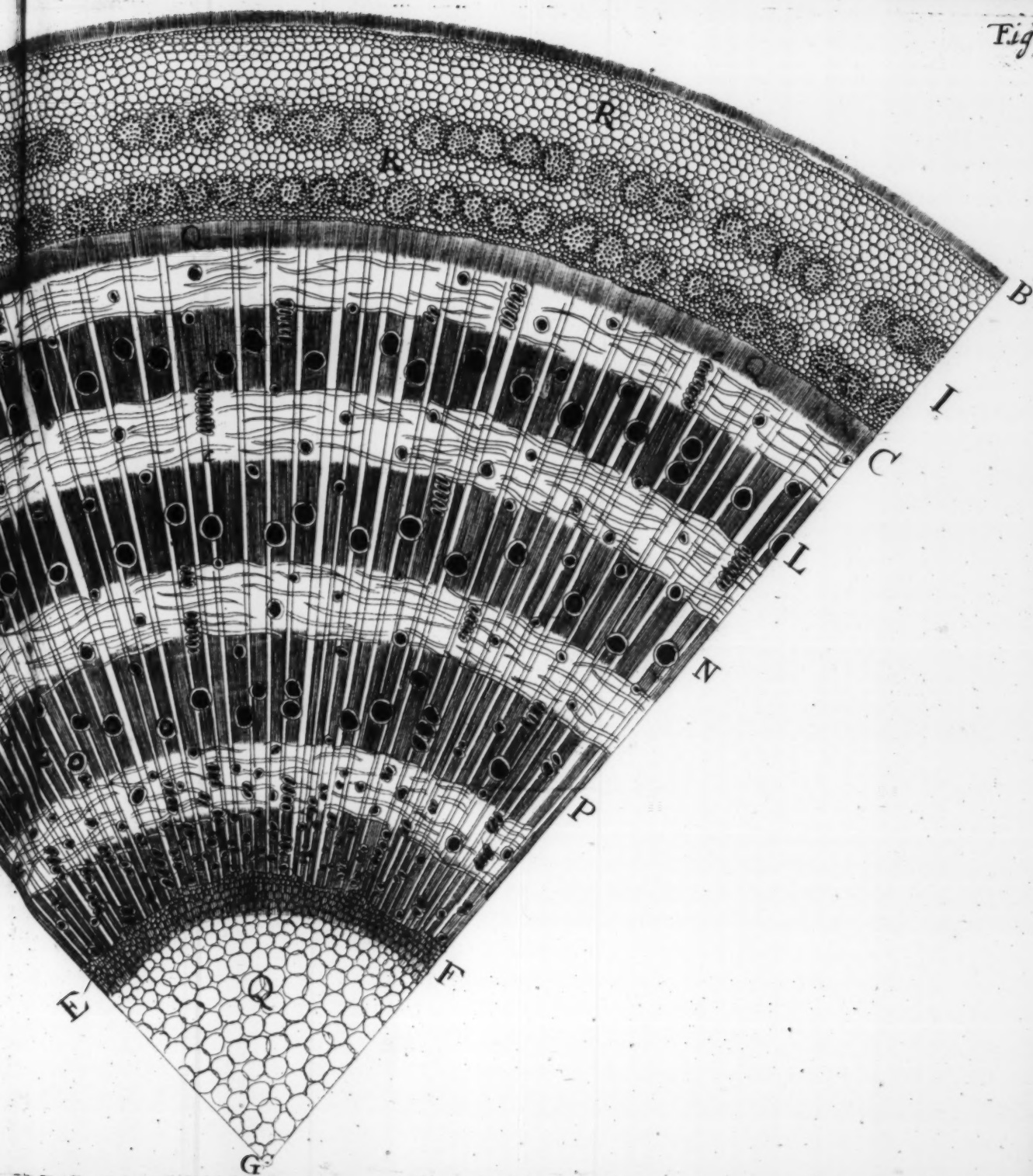


Fig 16



Figg Tree Branch.

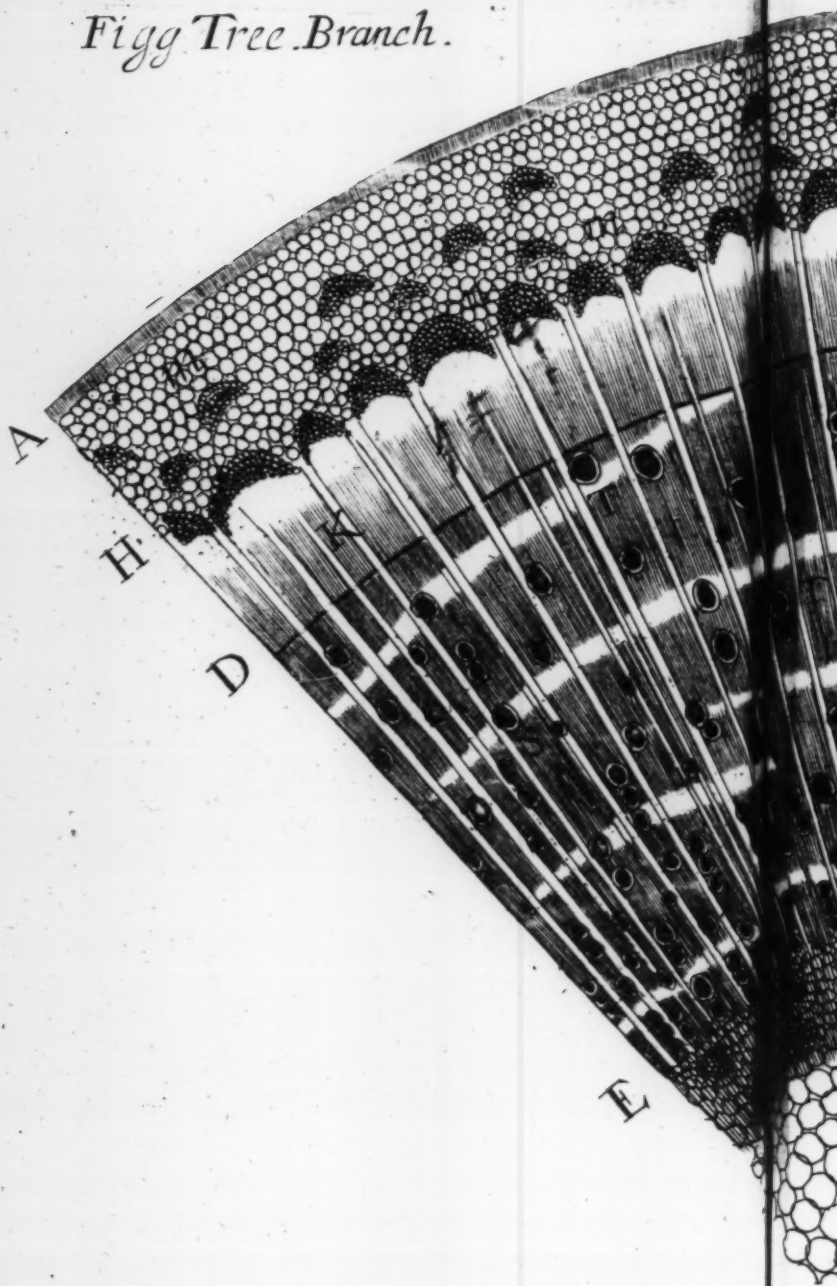
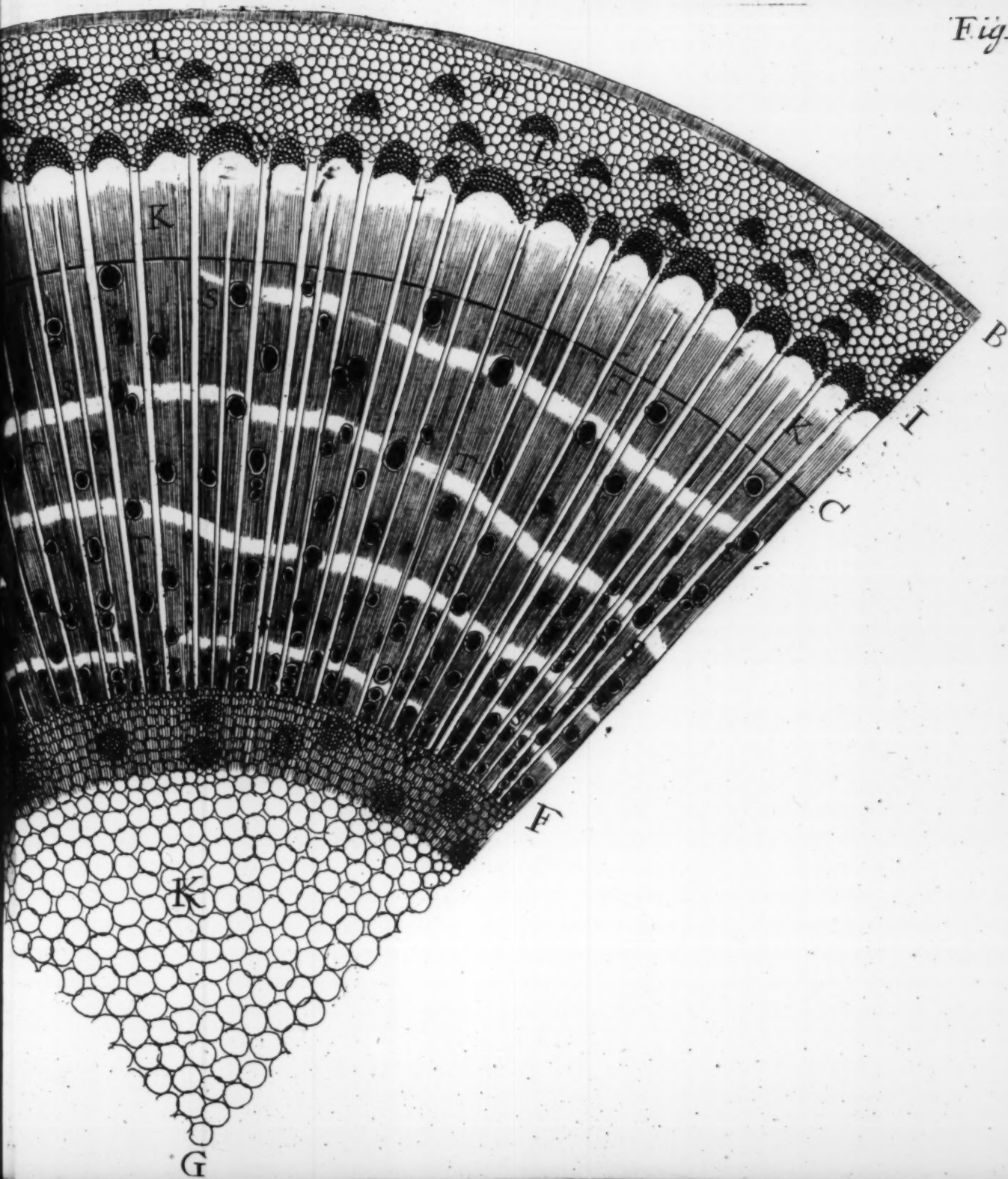


Fig. 17.



Pine Tree . Branch .

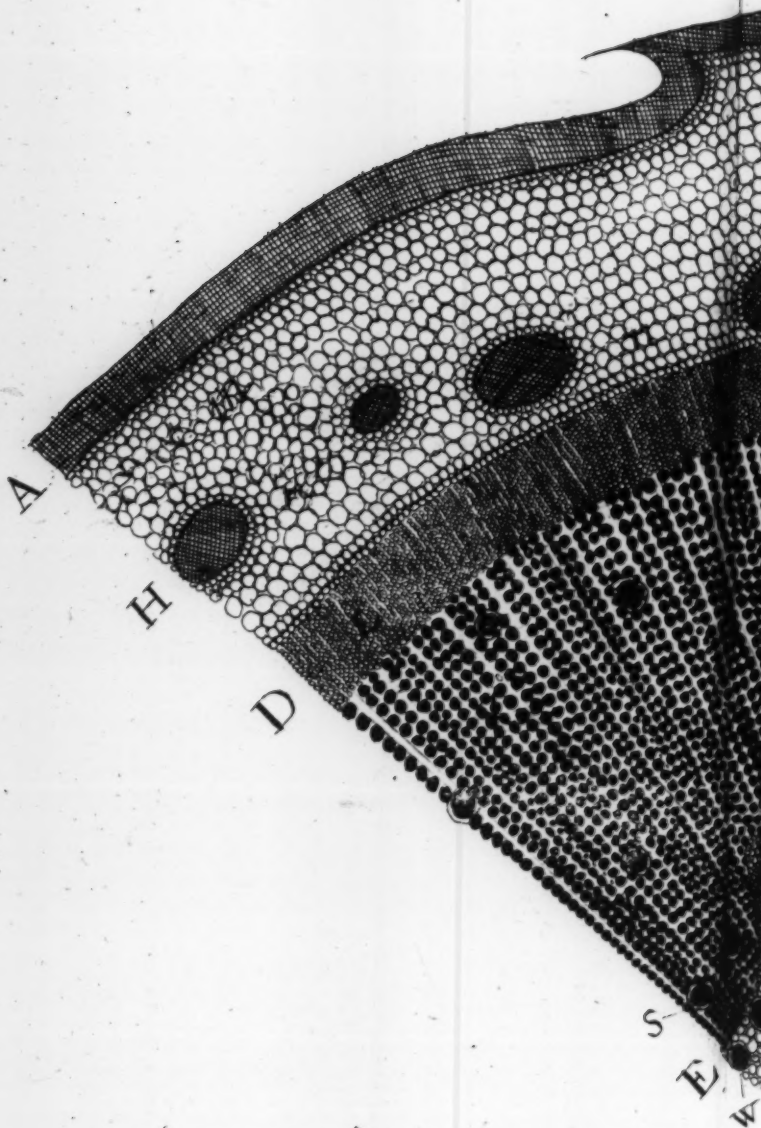
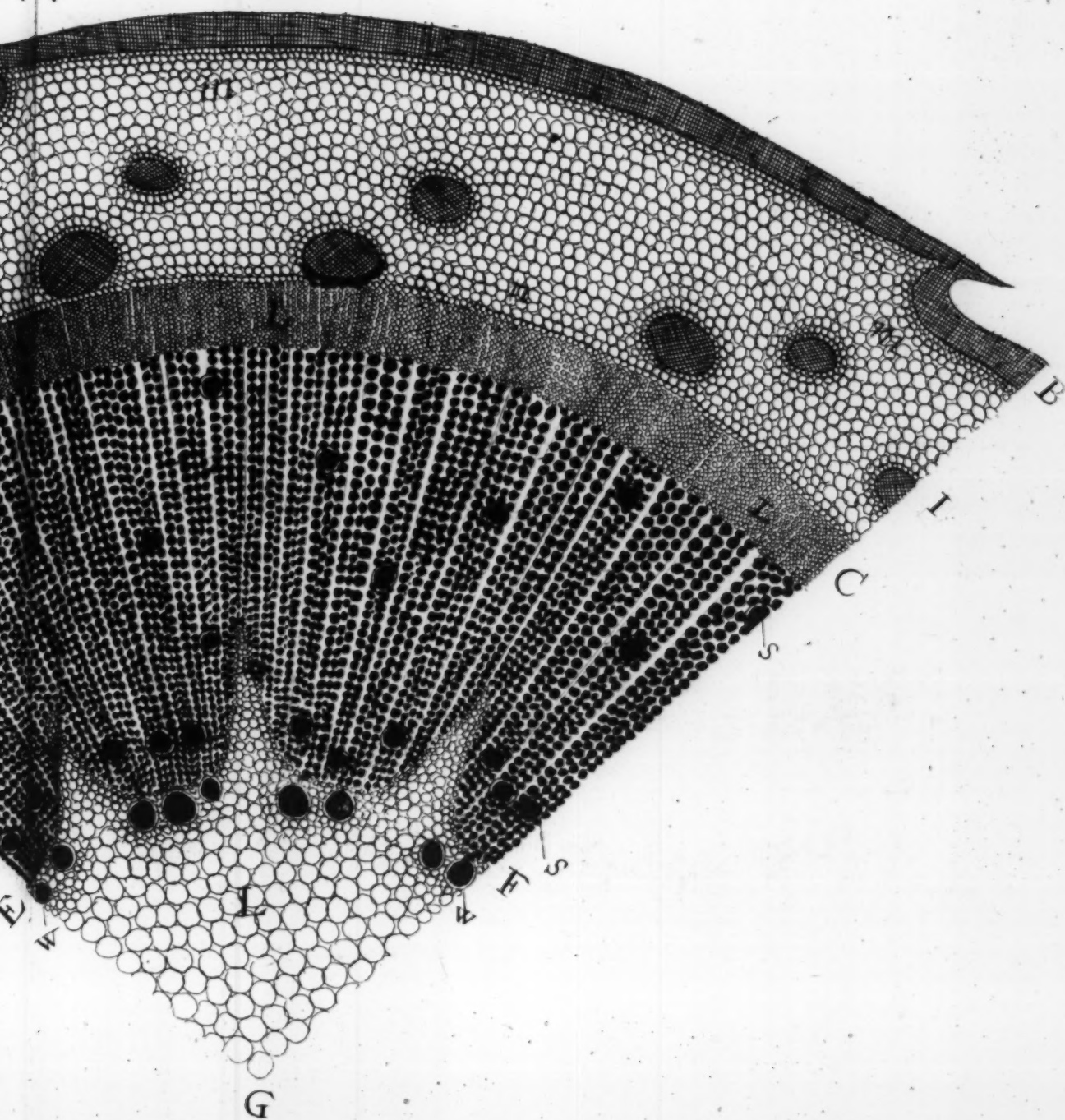


Fig. 18.



Oak Tree Branch.

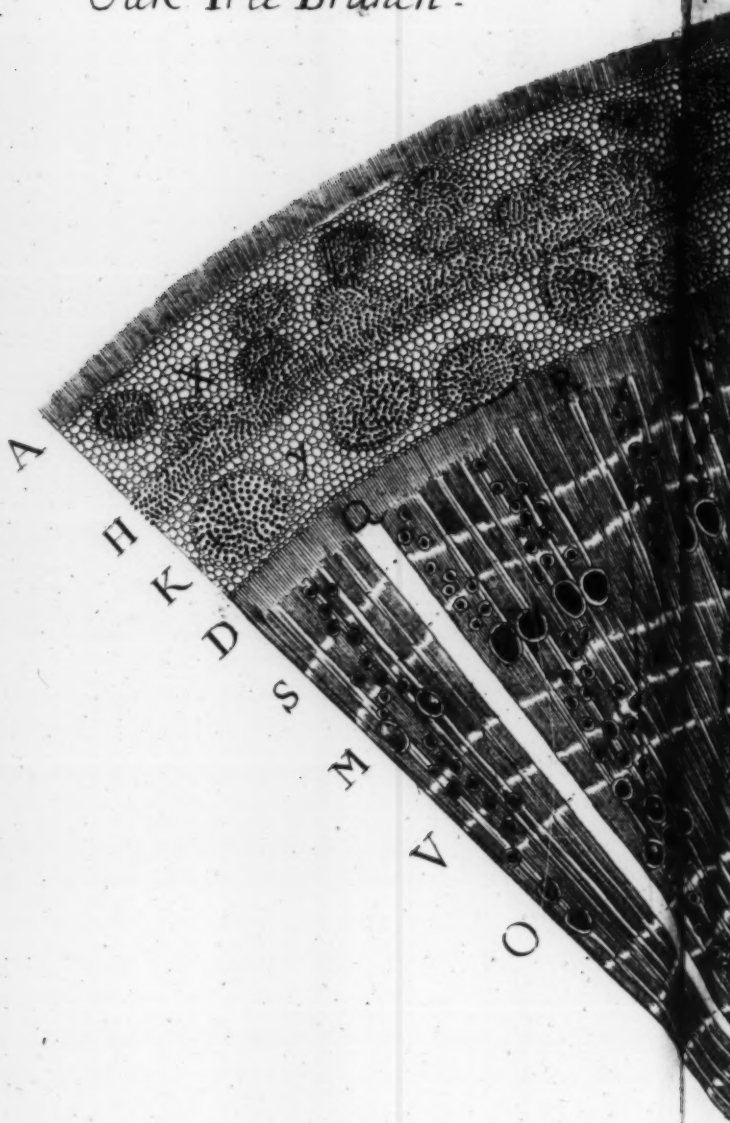
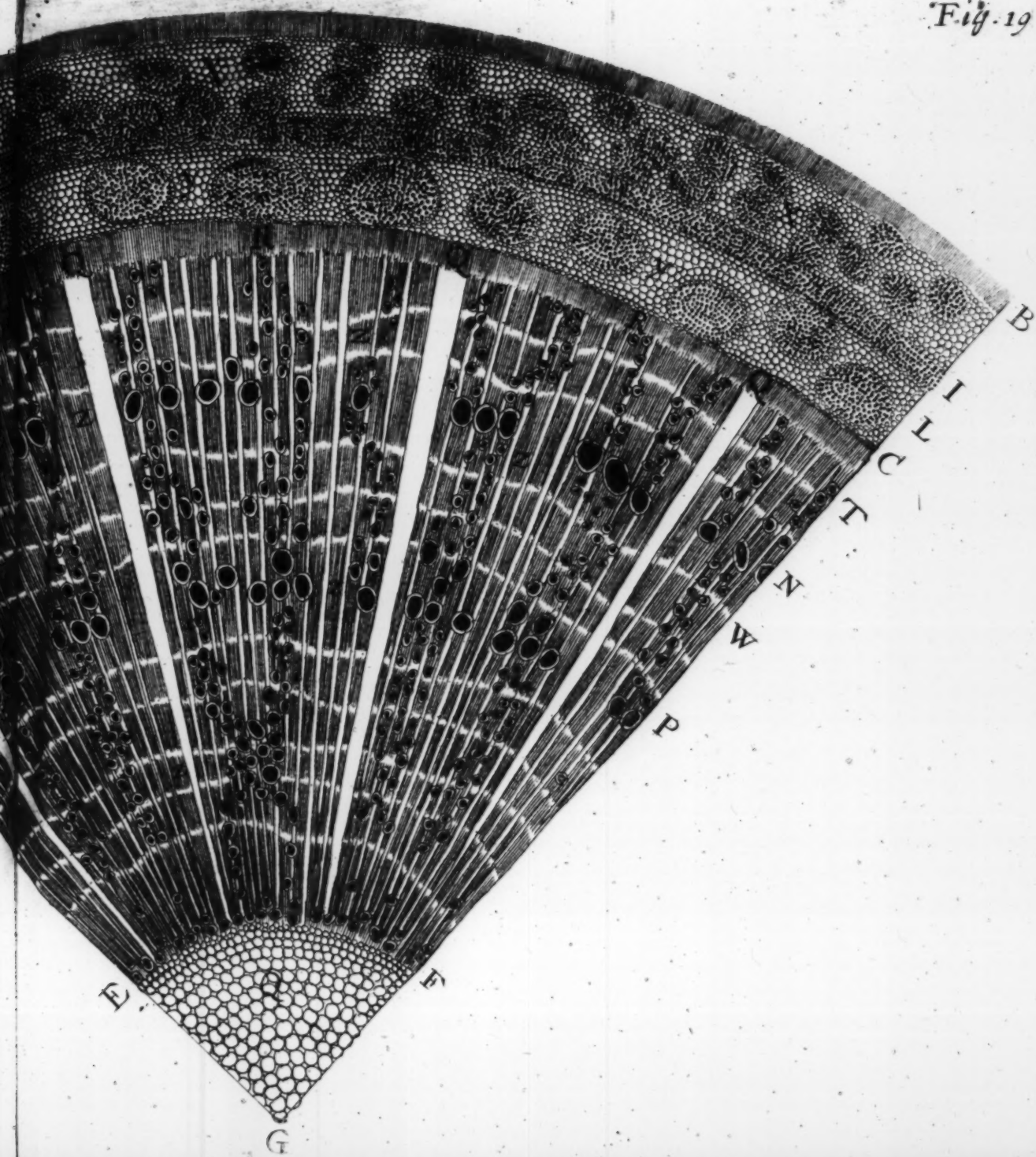


Fig. 19



Sumach.

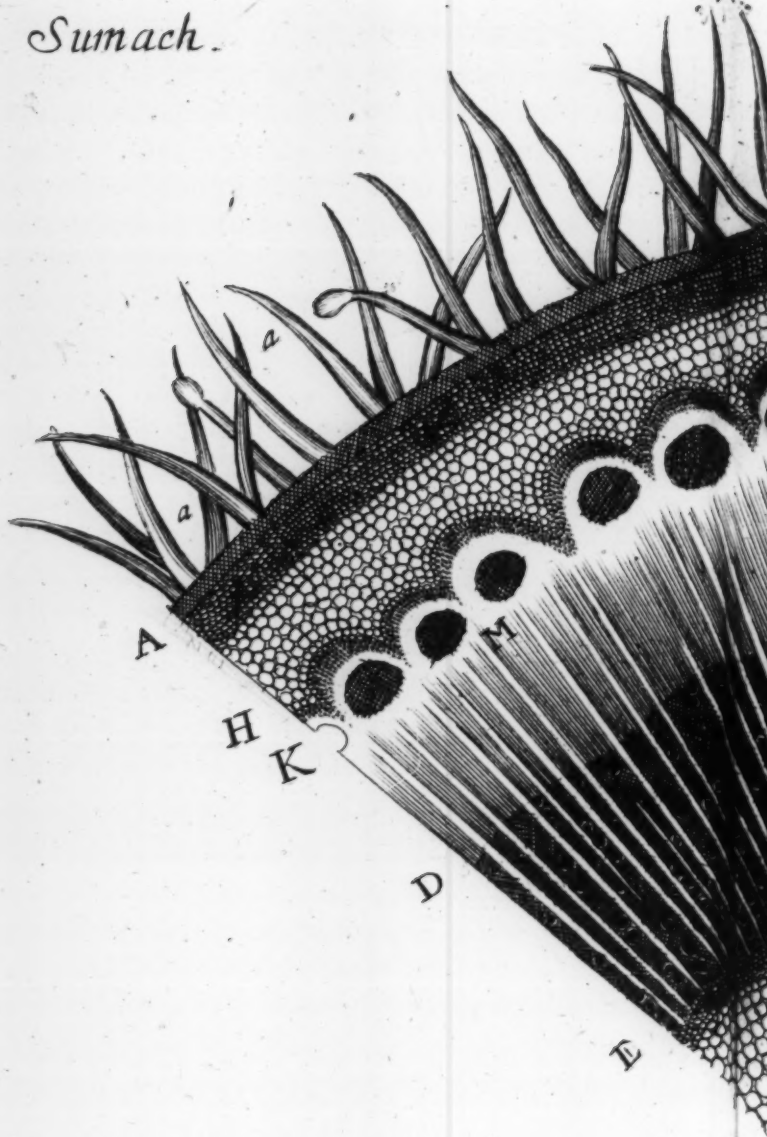
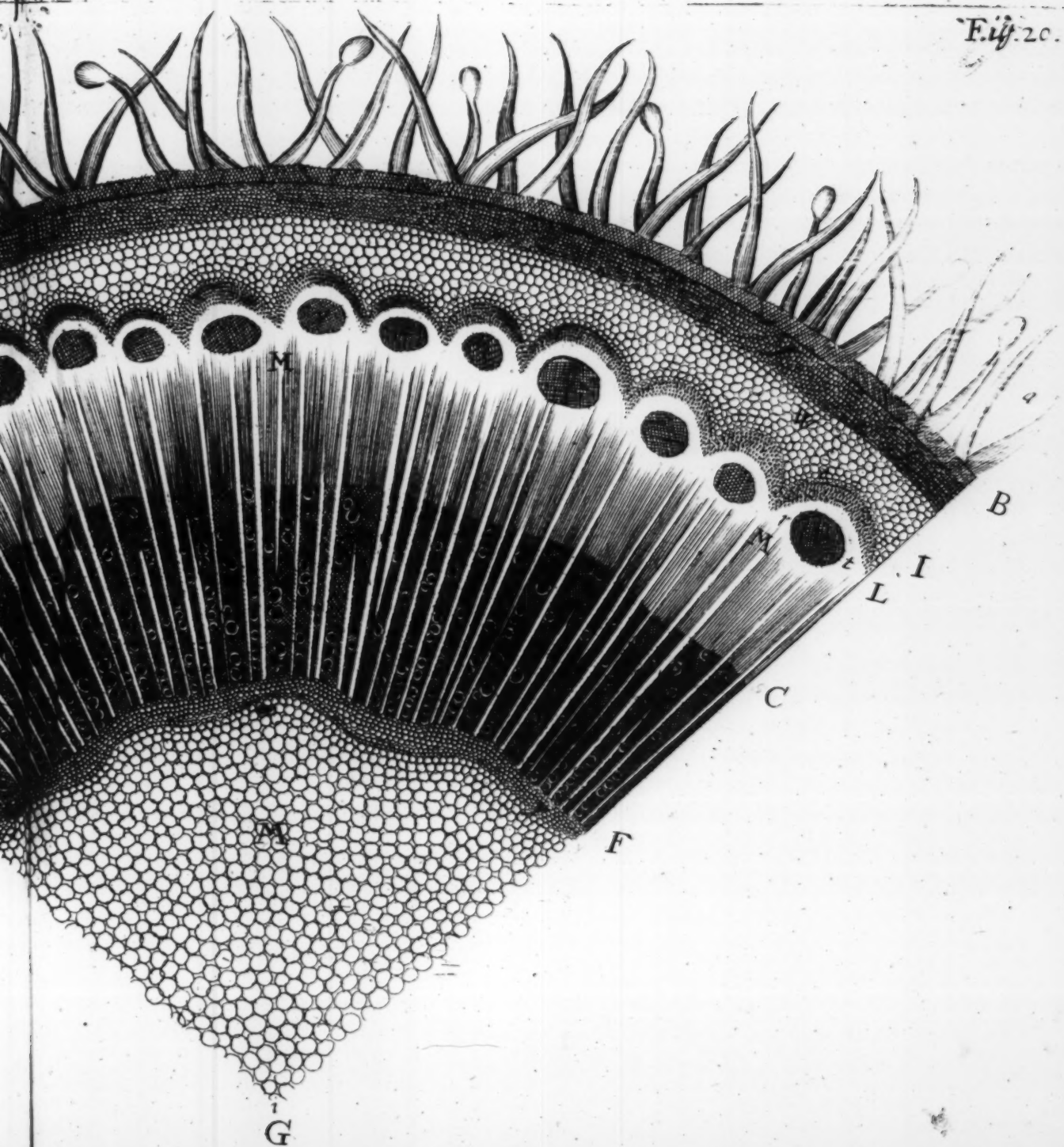


Fig. 20.



The Stalk of y^e Comōn Wormwood.

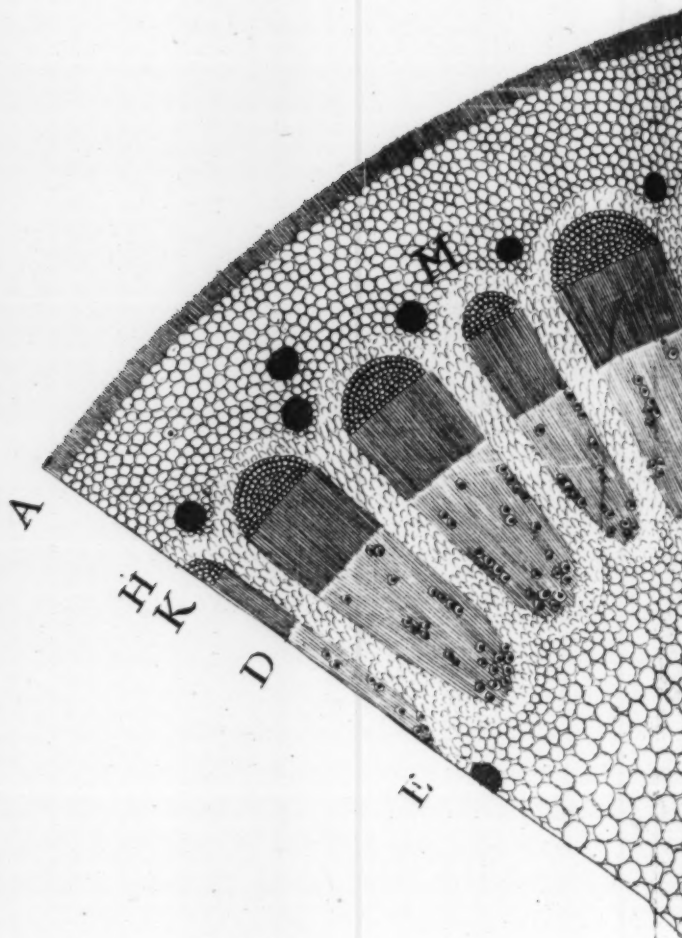


Fig. 21.

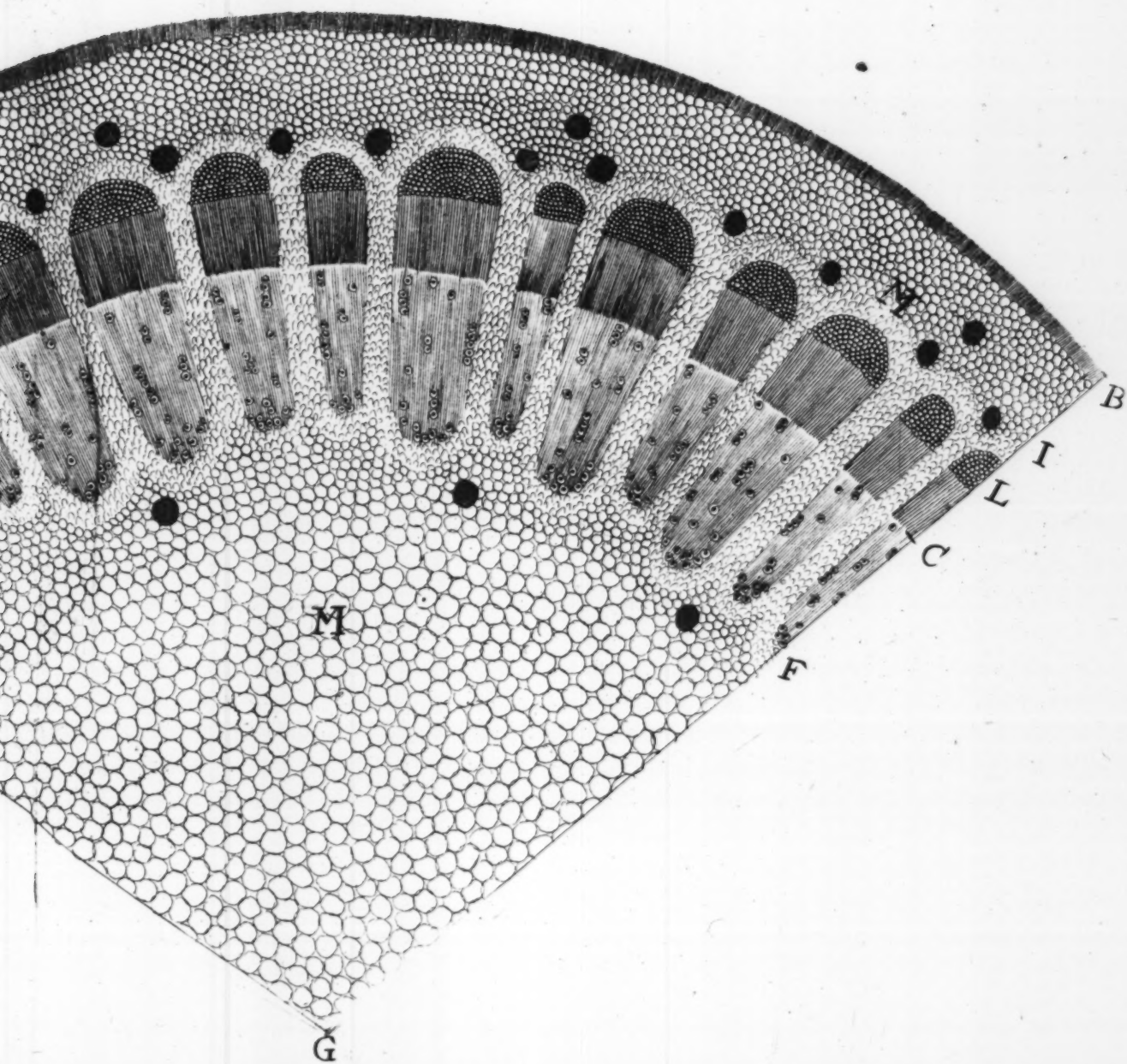


Fig 22

The Milk Vessils.

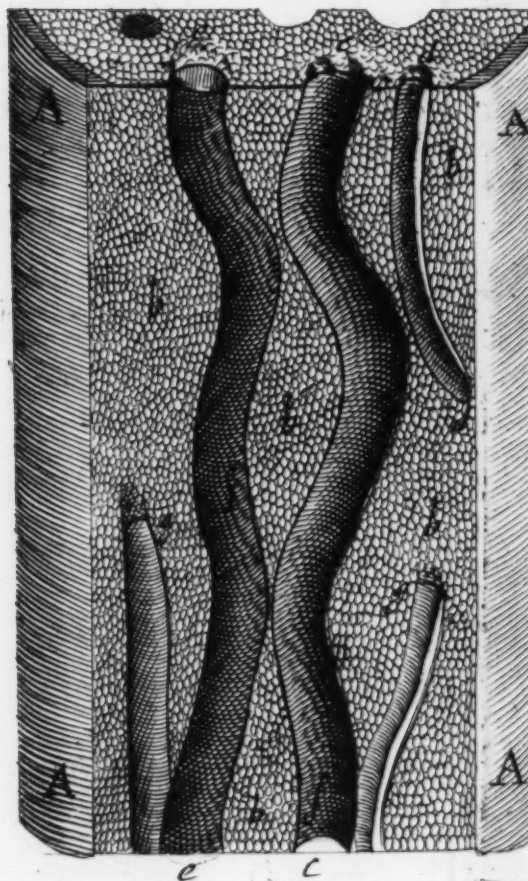


Fig. 23.

The . . . ^q Lymphæducts.

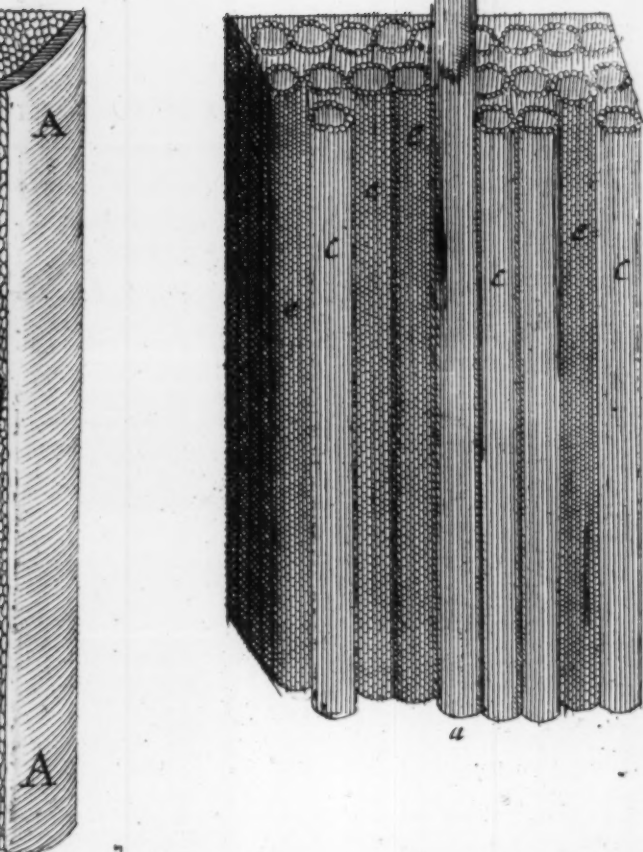


Fig. 24 The Aer Vessels.

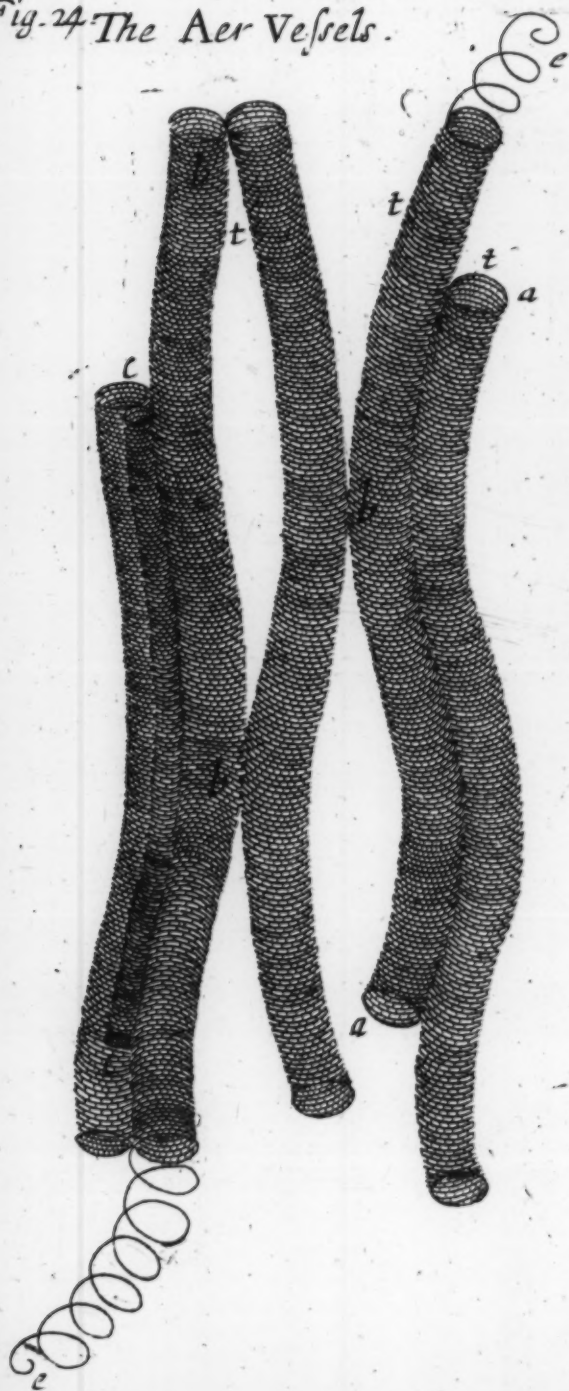


Fig 25

The Weffage of y^e Parenchyma
(or of y^e In sections) & Veffels.

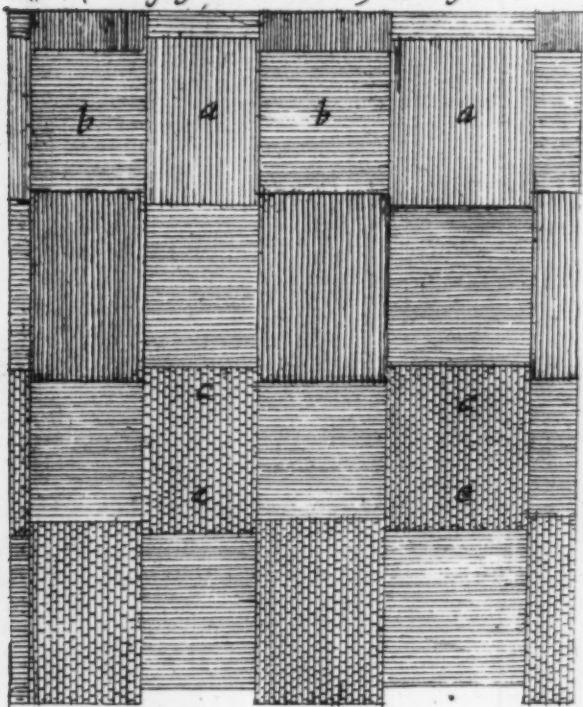
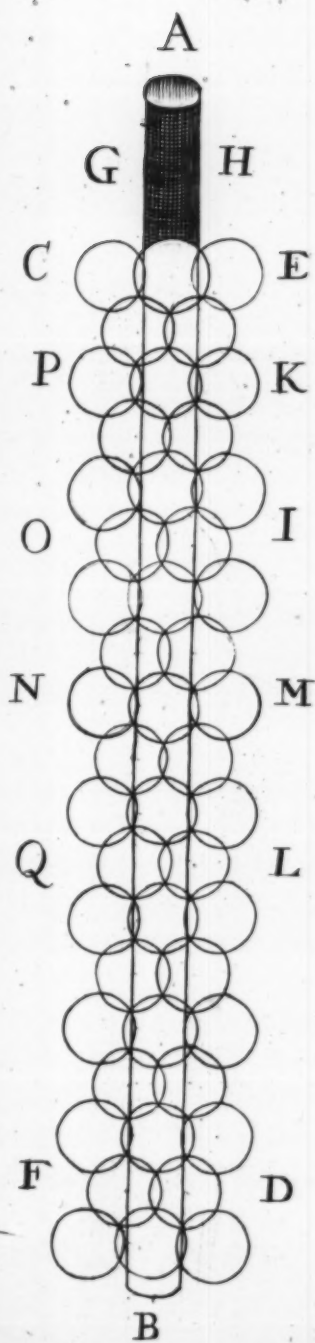


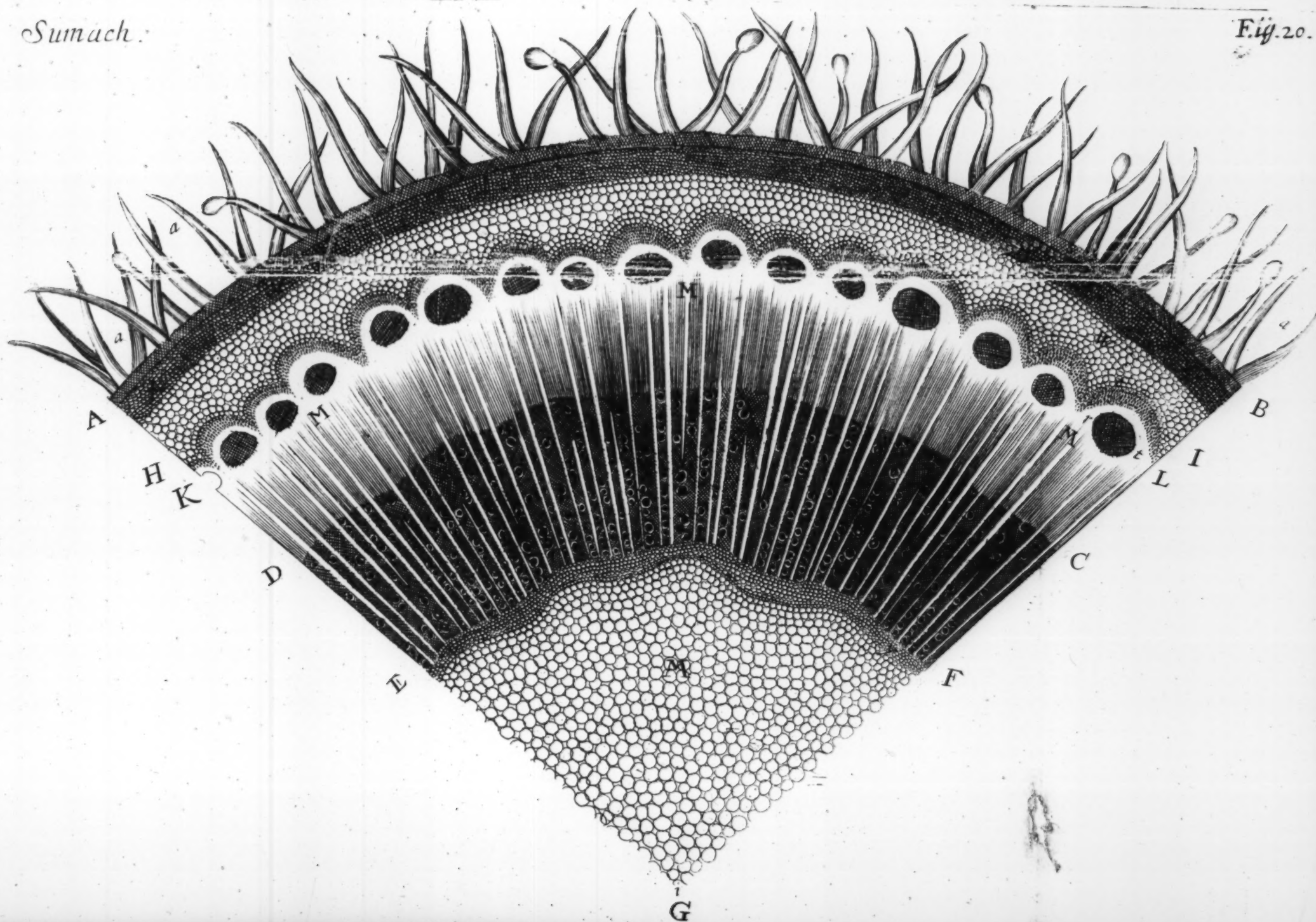
Fig: 27

19



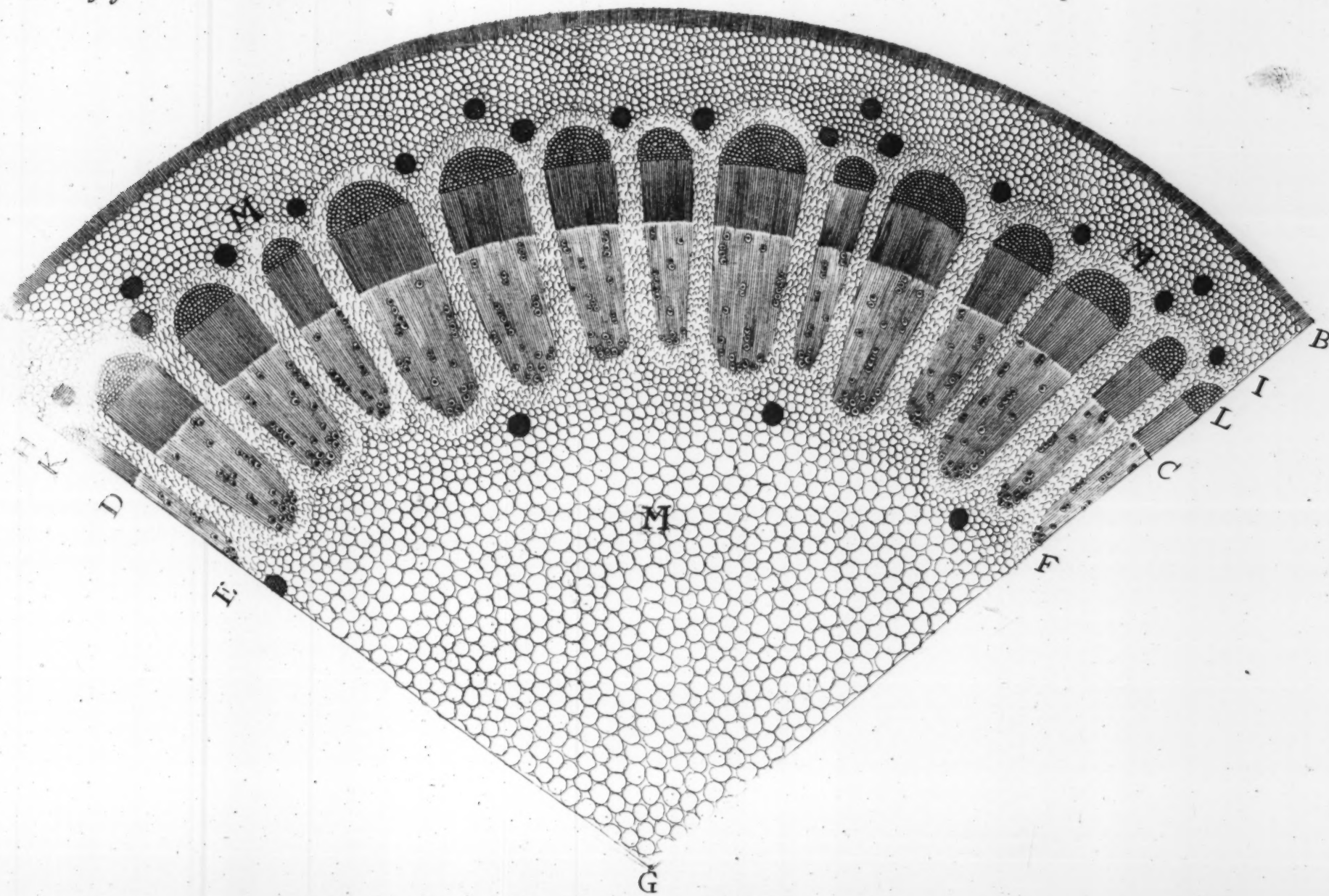
Sumach.

Fig. 20.



The Stalk of y^e Comon Wormwood.

Tab. 21.



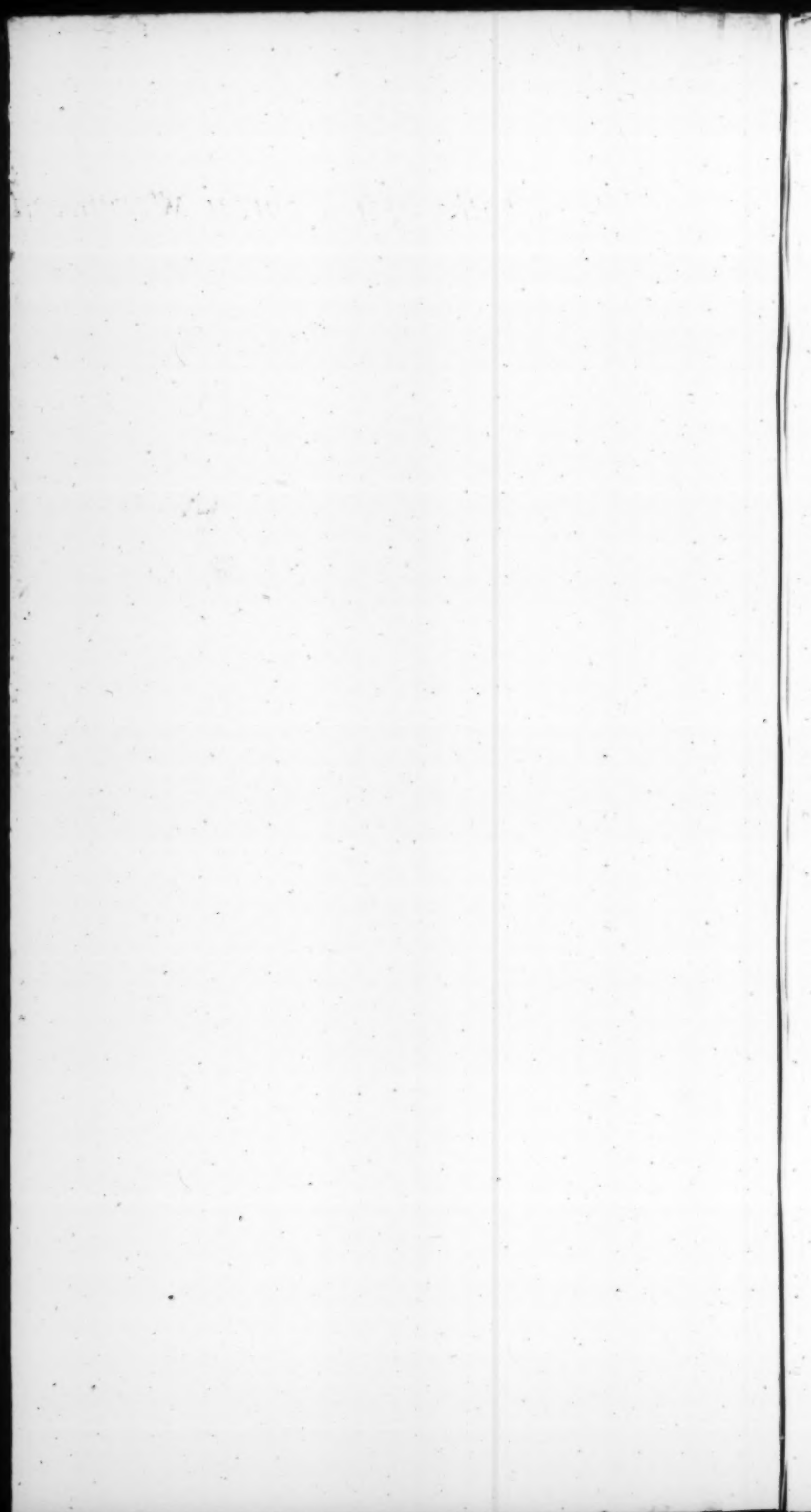


Fig 22

The Milk Vessels.

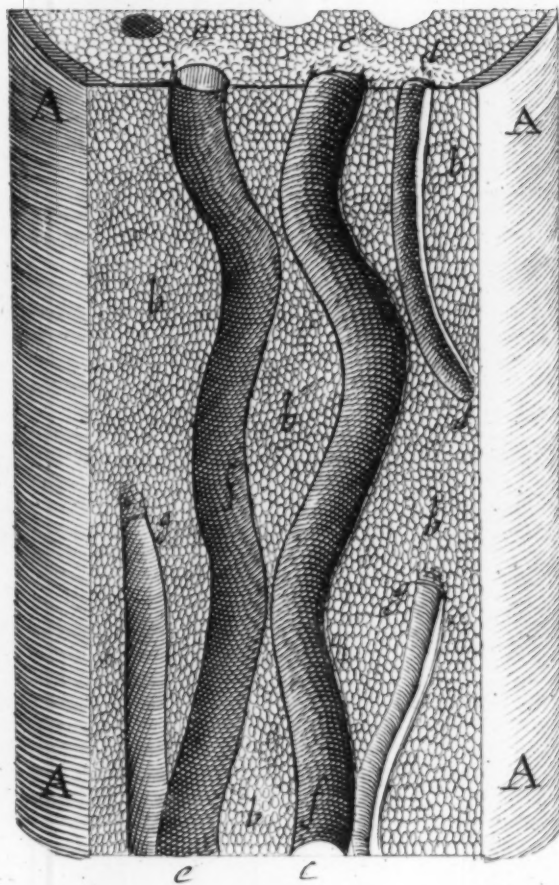
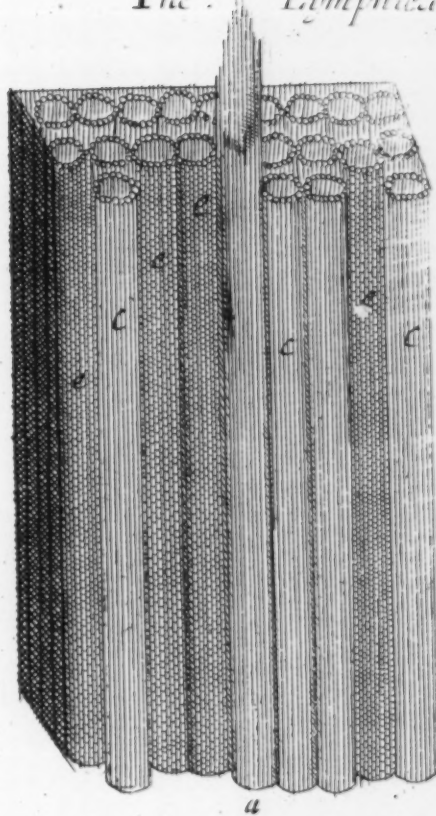


Fig. 23

The Lymphatics.



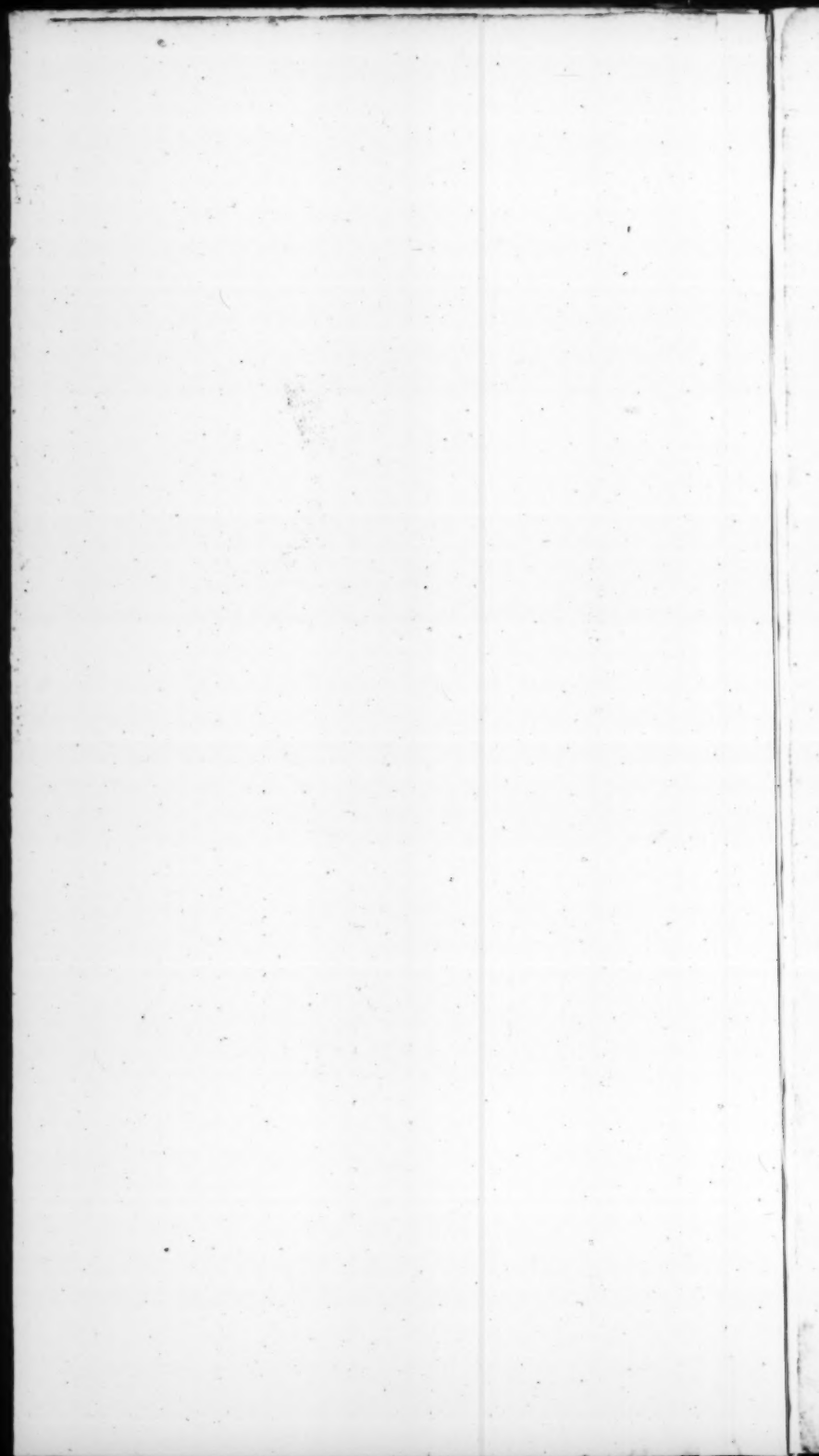


Fig. 24 The Aer Vessels.

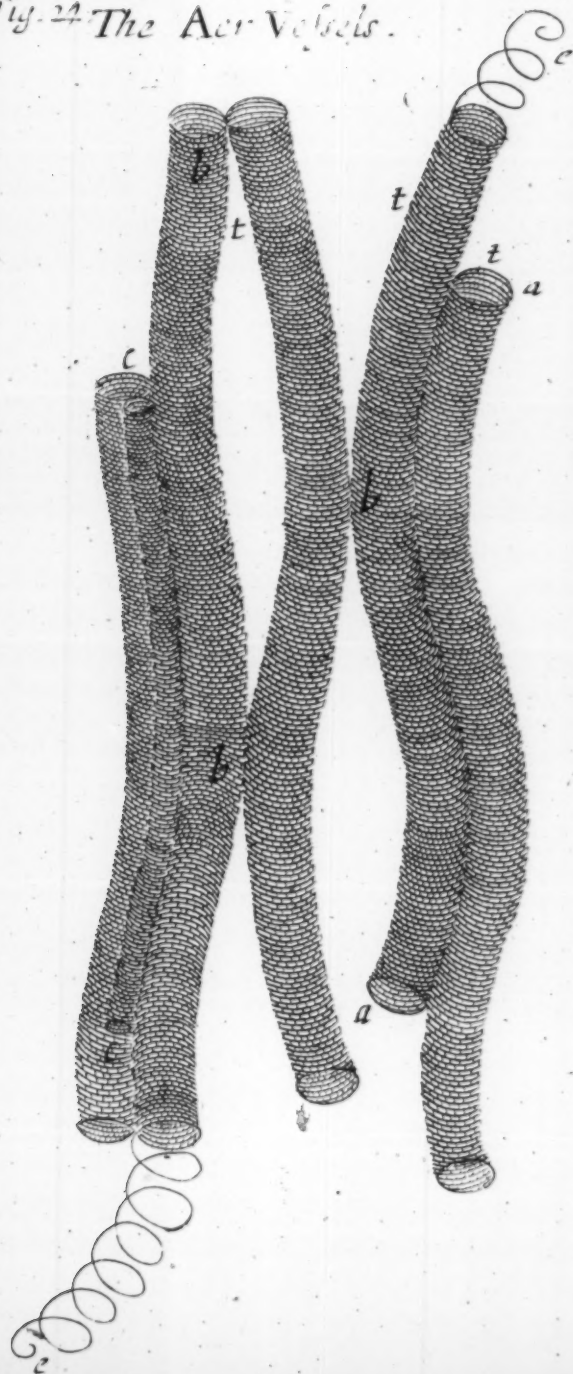
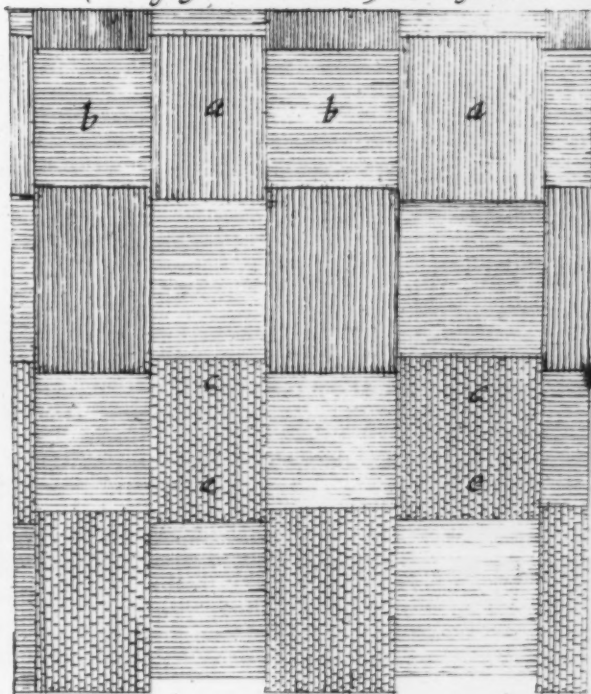
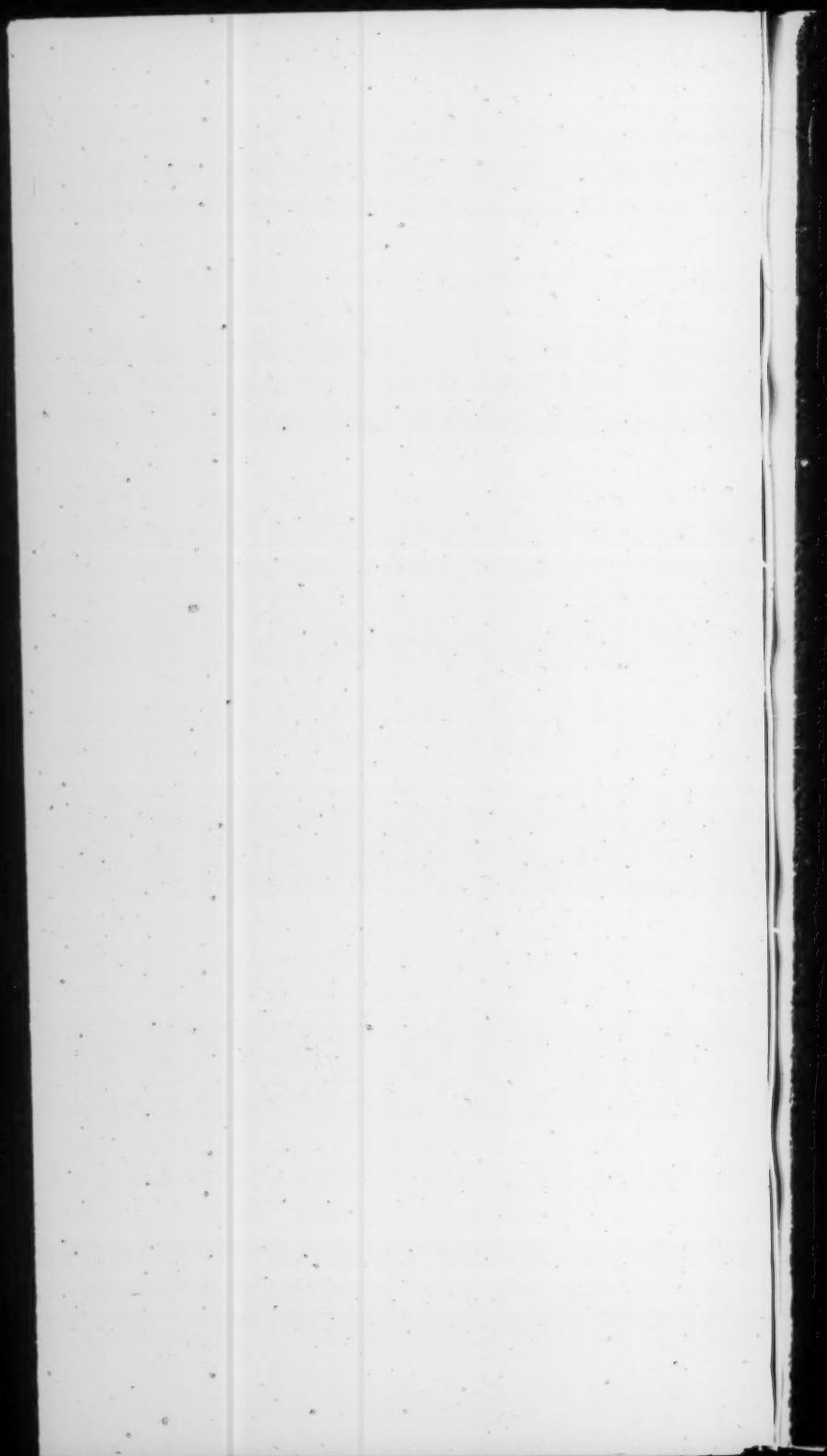
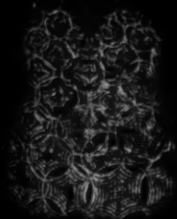


Fig. 25
The Weffage of y^e Parenchyma
(or of y^e Insections) & Vessels.





The Lesser Common Thistle



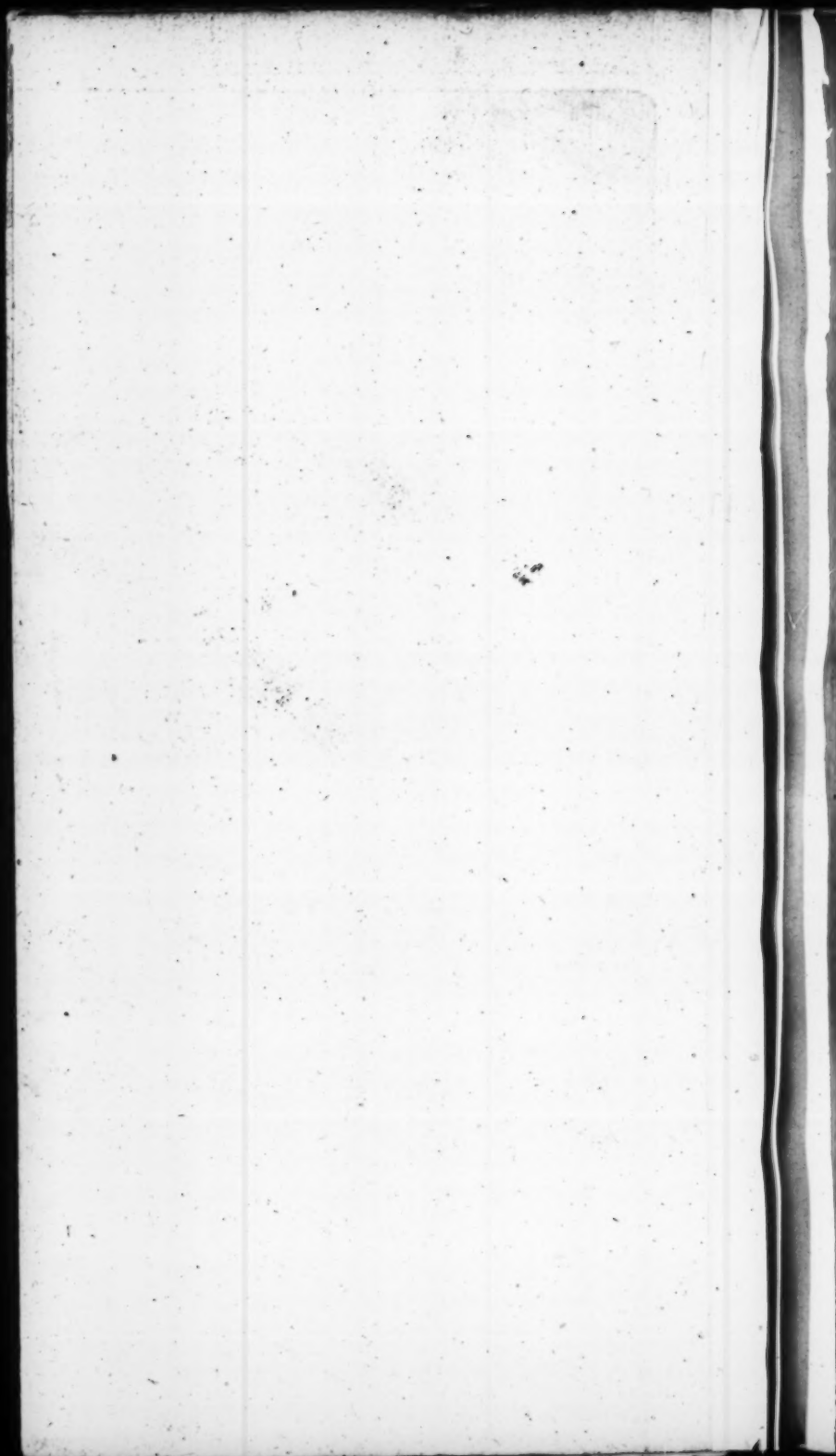


Fig: 27.

